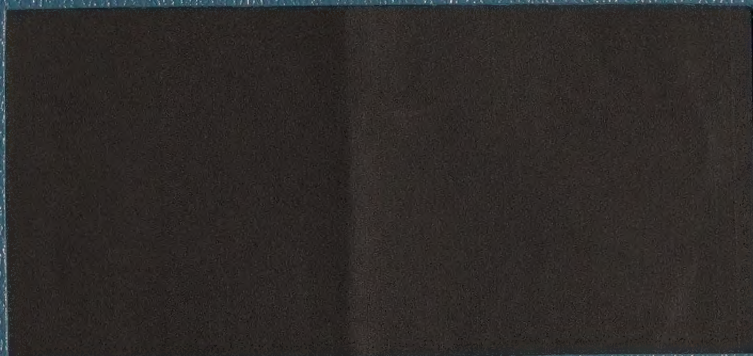
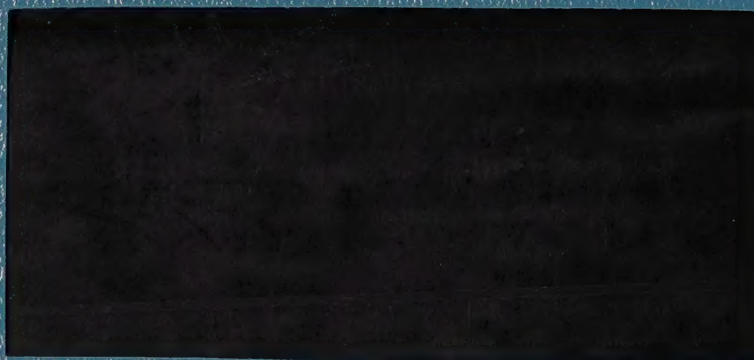






INSTRUCTION AND MAINTENANCE MANUAL

ITHACO S SERIES CASES

ITHACO P SERIES POWER SUPPLIES

ITHACO INC.

735 West Clinton Street

Ithaca, New York 14850

Telephone 607-272-7640

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MANUAL # 10

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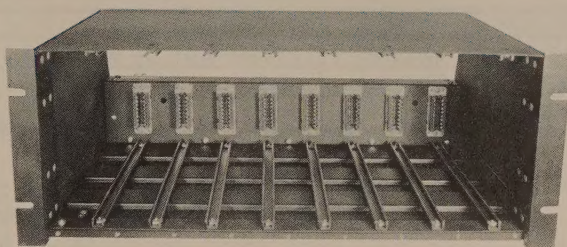
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REPLACEABLE PARTS

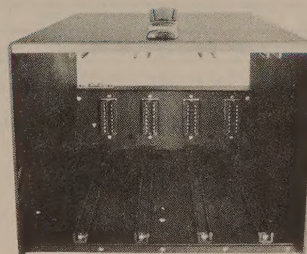
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P17
Power
Supply



S11 Rackmount



S21 Portable Case



Z1
Plug-In
Chassis

ITHACO's P Series Power Supplies and S Series cases provide maximum flexibility in the creation of single and multi-channel systems. The modular approach permits the user to build complex custom systems for current needs at minimum cost. Then at a later date the system can be modified to meet new requirements by substituting other plug-in modules.

The S Series Cases are used to house any ITHACO model which is packaged in a 6.75" high, 2" wide, and 10.5" deep plug-in chassis. The S10 Series accepts up to 7 plug-in channels for rackmount applications, while the S20 Series accepts up to 3 channels in a portable configuration. Any P Series Power Supply can be plugged into the extreme left

slot of the case to provide dc power and, for certain supplies, a calibration signal to all modules in the case.

P Series Power Supplies are dual-voltage, regulated power supplies which operate over a wide range of input voltages and frequencies, and feature electrostatic shielding, magnetic shielding, low noise, and low ripple. Additional features available include a 1 kHz calibration oscillator with power driver, and one of the following plug-in regulators:

+28 VDC, -28 VDC, or -55 VDC

Provisions have been made in all models for standby battery operation from external batteries.

The following table shows compatible power supplies and cases for various products:

MODELS	7-CHANNEL RACKMOUNTS	3-CHANNEL PORTABLE CASES	P SERIES POWER SUPPLIES
451, 452, 453, 454, 361, 381, 3152, 3153, 3161, 4111, 4112, 4113, 4114, 4115	S11	S21	P11 ¹ through P17 Type R (rechargeable)
455, 456	S11	S21	P14
461 ³	S11	S21	P17 ^{1,2} , P13 ² , P16 ²
471 ³	S11 (Option 01 required)	S21 (Option 01 required)	P16 ²

¹ Recommended model

² Includes calibration oscillator

³ Includes calibration circuitry

POWER SUPPLY SPECIFICATIONS

INPUT FREQUENCY

47 Hz - 440 Hz

INPUT VOLTAGE

Taps on the primary of the power transformer are wired:

STANDARD	117 Volts Nominal	(105V - 130V)
OPTION 01	100 Volts Nominal	(90V - 110V)
OPTION 02	200 Volts Nominal	(180V - 220V)
OPTION 03	235 Volts Nominal	(210V - 260V)

POWER SUPPLY SPECIFICATIONS (CONTINUED)

OUTPUTS

FUNCTION	P11	P12	P13	P14	P15	P16	P17
±15V	YES	YES	YES	YES	YES	YES	YES
PREAMPLIFIER POWER	NO	+28V	+28V	NO	-28V	-28V	NO
-55V	NO	NO	NO	YES	NO	NO	NO
CAL OSCILLATOR	NO	NO	YES	NO	NO	YES	YES
RELAY POWER	NO	NO	+24 to +28V	NO	NO	+24 to +28V	+24 to +28V

	CURRENT	LINE REG.	LOAD REG.	RIPPLE	NOISE	STABILITY	ACCURACY
±15V	1000 MA	0.05%	0.01%	20μV rms	25μV rms	±0.1%	ADJ.
±28V	200 MA	0.05%	0.1%	20μV rms	40μV rms	±1%	±3%
-55V	100 MA	0.05%	0.1%	20μV rms	40μV rms	±0.1%	±3%

CAL OSCILLATOR/BUFFER (Models P13, P16, P17 only)

FREQUENCY

Accuracy	1 KHz ±5%
Stability	1% Time and Temperature

AMPLITUDE

Level	0.707 to 1V rms, internally adjustable
Stability	±0.5% Time and Temperature
Distortion	0.5% maximum

OUTPUT REGULATION

(1V rms Out)

0.25% with 50Ω Load
1% with 10Ω Load
2% with 7Ω Load

CONTROLS

Cal Switch	Front Panel Toggle
	Cal/Operate
Cal Monitor	Isolated Front Panel BNC

CASE SPECIFICATIONS

	MODEL S11 RACKMOUNT	MODEL S21 PORTABLE CASE
SIZE	7" high, 19" wide, 14" deep	7" high, 9.5" wide, 14" deep
CAPACITY	7 channels plus power supply	3 channels plus power supply
PAINT	Black	Black

ACCESSORIES

X1	EXTENDER CABLE	A blank plug-in chassis with extension cable
Y1	BLANK PANEL	
Z1	BLANK PLUG-IN CHASSIS	Permits integration of user's circuitry

MODEL R POWER SUPPLY

INTRODUCTION

The Model R Power Supply is essentially a DC regulated battery pack with the capability of recharging the battery from the 117V, 60 Hz line. Current capacity of Model R is approximately 30 channel-hours, and thus it is intended for use primarily with a maximum of 3 channels. However, Model R may be used to operate up to 7 channels of 450 Series Amplifiers with a resultant decrease in operating time. The operating time may be extended by leaving Model R in the recharge mode, however, the battery will ultimately become discharged to the point where the amplifiers will not operate properly. This then necessitates placing the AMPL switch in the OFF position to allow the battery to recharge.

OPERATING INSTRUCTIONS

GENERAL

The Model R Power Supply is designed to operate in the extreme left slot of either a S11 Rackmount or S21 Portable Case. It may also be operated outside of either of these mountings provided an Amphenol Blue Ribbon #26-4100-16S connector is mated with the power supply rear connector, and the following pin connections are used:

<u>PIN</u>	<u>CONNECTION</u>
1	-15 V $\pm 1\%$
2	Signal Ground
9	+15 V $\pm 1\%$

The above pin convention and connector specification also applies to the 450 Series Amplifiers. The Model R package is tied to the third wire AC ground, so care must be taken to insure that Model R does not physically contact the package of a 450 Series Amplifier, since the amplifier package is at signal ground.

RECHARGE MODE OPERATION

To recharge the battery, connect Model R to the 117V, 60 Hz line by means of the power cord at the rear. Place the CHG switch in the ON position and the AMPL switch in the OFF position. This permits the battery to be charged without draining current into the DC regulator or the amplifiers. No meter indication will occur in this situation. Model R may be removed from the Rackmount or Portable Case for recharging.

To permit extended charging time without damage to the batteries, the charging current is set at a low level. For this reason, a discharged battery should be charged for a minimum of 16 hours.

AMPLIFIER OPERATION MODE

Model R may be used to operate any of the 450 Series Amplifiers. It may further be used with the CHG switch in either the ON or OFF position. The CHG switch

serves to connect and disconnect the rectification and filtering circuits to the 60 Hz line. The AMPL switch connects the regulator, meter and amplifiers to the DC power lines.

When used with the CHG switch in the OFF position and the AMPL switch in the ON position, the meter and amplifier are connected to the DC lines. The battery has a 1.2 amp-hour rating. Thus, since the regulator requires approximately 15 ma and each 450 Series Amplifier requires approximately 35 ma, a fully charged battery should operate 3 channels for at least 8 hours or 7 channels for at least 5 hours. When the meter drops below mid-scale (approximately $\pm 16.5V$) the DC regulator will not function properly, and proper amplifier operation cannot be guaranteed.

When used with the CHG switch in the ON position and the power cord connected to the AC line, the possible operating time may be extended. In this situation, it may be possible to reach an equilibrium point for 3 channel operation in which the battery will remain partially discharged. For 7 channel operation, the battery will eventually become fully discharged.

MAINTENANCE AND CALIBRATION

GENERAL

Access to the circuitry of Model R is obtained by removing two side panel screws from the right side panel, and sliding the panel towards the rear. The regulator card may be removed by sliding its retaining spring, located in the upper structural member, towards the front. The card should then be lifted into the upper slot, its lower edge pulled out and down, thus freeing it from the Power Supply structure. The left side panel may be removed by first removing the two retaining screws at either end of the panel. Care should be taken during this operation to avoid breaking the battery connections to the front panel AMPL switch. The battery is secured by two screws to the left side panel, and may be removed from this panel by removing the two screws.

Model R has an integral current limiting feature in each polarity which limits output current to 400 ma, and a power output diode protection which holds both polarities at ground when they are shorted together. Thus, before assessing the lack of DC power to a power supply failure, the power supply output should be checked with no amplifiers connected to it.

BATTERY REPLACEMENT

The battery pack consists of 30 rechargeable NiCd 1.5V cells, (Burgess CD12L or equivalent) interconnected to provide a maximum of $\pm 22V$. The cells are potted in 3M Scotchcast Number 22 to form a solid block. The user may replace individual cells or may purchase a replacement battery pack, ITHACO #C30588, from the factory. When purchasing a replacement battery pack, refer to Model R as well as the above ITHACO part number.

To install a replacement battery, disconnect the old battery, and connect the replacement in the same manner as the old battery.

CALIBRATION

The only calibration which may be necessary is an adjustment of the regulator output voltages. This adjustment is provided by potentiometer R25 for the positive regulator and potentiometer R24 for the negative regulator. Both controls are located on the regulator card.

POWER SUPPLY FAILURE

For assistance in troubleshooting the regulator card, reference should be made to Drawing C30564. Troubleshooting should only be performed by persons familiar with solid state circuitry and conventional solid stage troubleshooting techniques.

SECTION 2

2.0 INSTALLATION

2.1 INSPECTION

2.1.1 GENERAL

Before shipment, this unit was found to be free of electrical and mechanical defects. As soon as the instrument is unpacked, inspect for any damage that may have occurred in transit. Save all packing materials until the inspection is complete. If damaged in any way, a claim should be filed with the carrier and a copy forwarded to ITHACO. ITHACO will then advise you as to the disposition of the equipment and will arrange for repair or replacement without waiting for a claim against the carrier.

2.1.2 VISUAL INSPECTION

A visual check should be made to confirm that there are no broken knobs or connectors, and that the case and panel surfaces are free of dents and scratches.

2.1.3 ELECTRICAL INSPECTION

The instrument should be checked against its electrical specifications.

2.2 POWER SOURCE REQUIREMENTS

P Series Power Supplies will operate within specifications from power frequencies for 47 Hz to 440 Hz and a wide range of input voltages depending on the connections of the power transformer. Four input voltage options are available from the factory.

Standard Input Voltage	117V nominal (105V to 130V)
Option 01	100V nominal (90V to 110V)
Option 02	200V nominal (180V to 220V)
Option 03	234V nominal (210V to 260V)

NOTE: Connections required for each of the input voltage ranges is described on the Power Supply Primary Power Wiring Diagram.

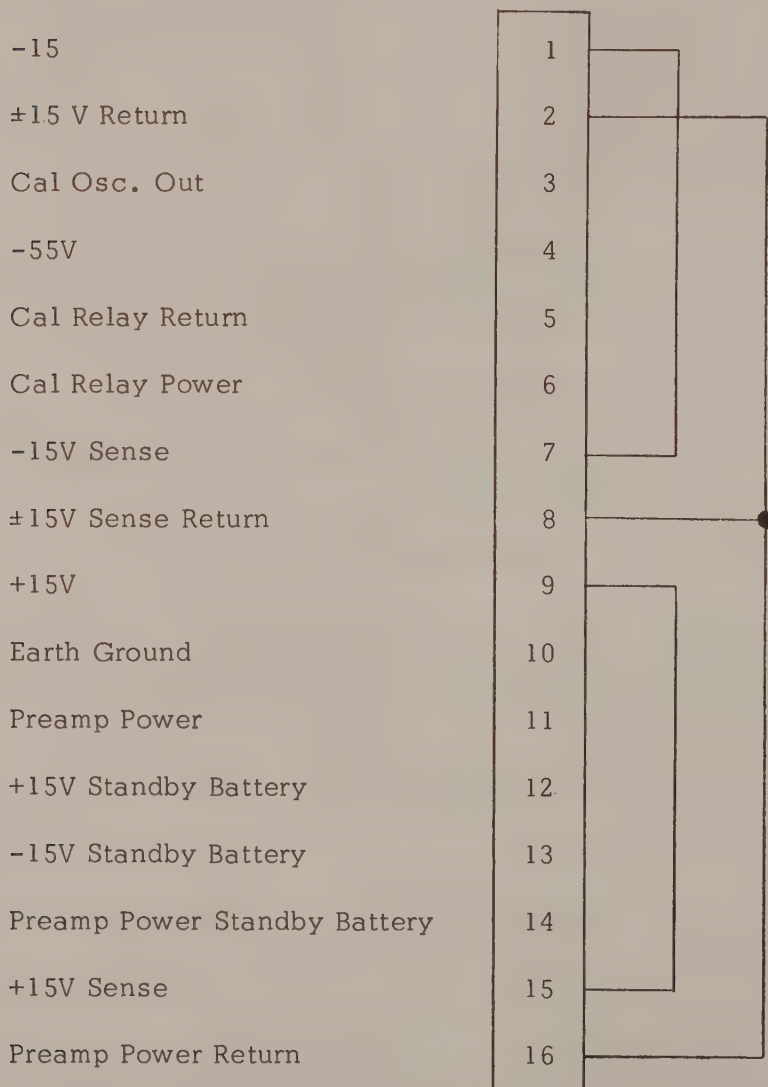
2.3 STANDBY BATTERY OPERATION

The service connector on the rear of the S Series cases has connections for standby battery operation. Figure 2.3 shows the connections for standby battery operation for various P Series Power Supplies. External fuses should be provided to protect the batteries during an accidental short.

2.4 INDEPENDENT POWER SUPPLY OPERATION

For operation of the P Series Power Supplies independent of the S Series mounting cases, the connections shown below must be made:

Mating: AMPHENOL BLUE RIBBON #26-4200-16S



2.5 SYSTEM GROUNDS

A system ground terminal is provided on the rear of each S Series case which permits the power ground to be jumpered to system ground by means of a terminal clip. In those systems which operate with other portions of the system connected to power ground, it may be advantageous to operate without this jumper. The P Series Power Supply chassis and the S Series Cases are always connected to power ground. The plug-in instrument chassis is isolated from the case and connected to circuit ground.

2.6 INTER-CHANNEL WIRING

The S Series Cases provide interchannel wiring of power and calibration, but in most cases input, output and control connections are made on the rear of the plug-in chassis. Refer to wiring diagram for the particular S Series case.

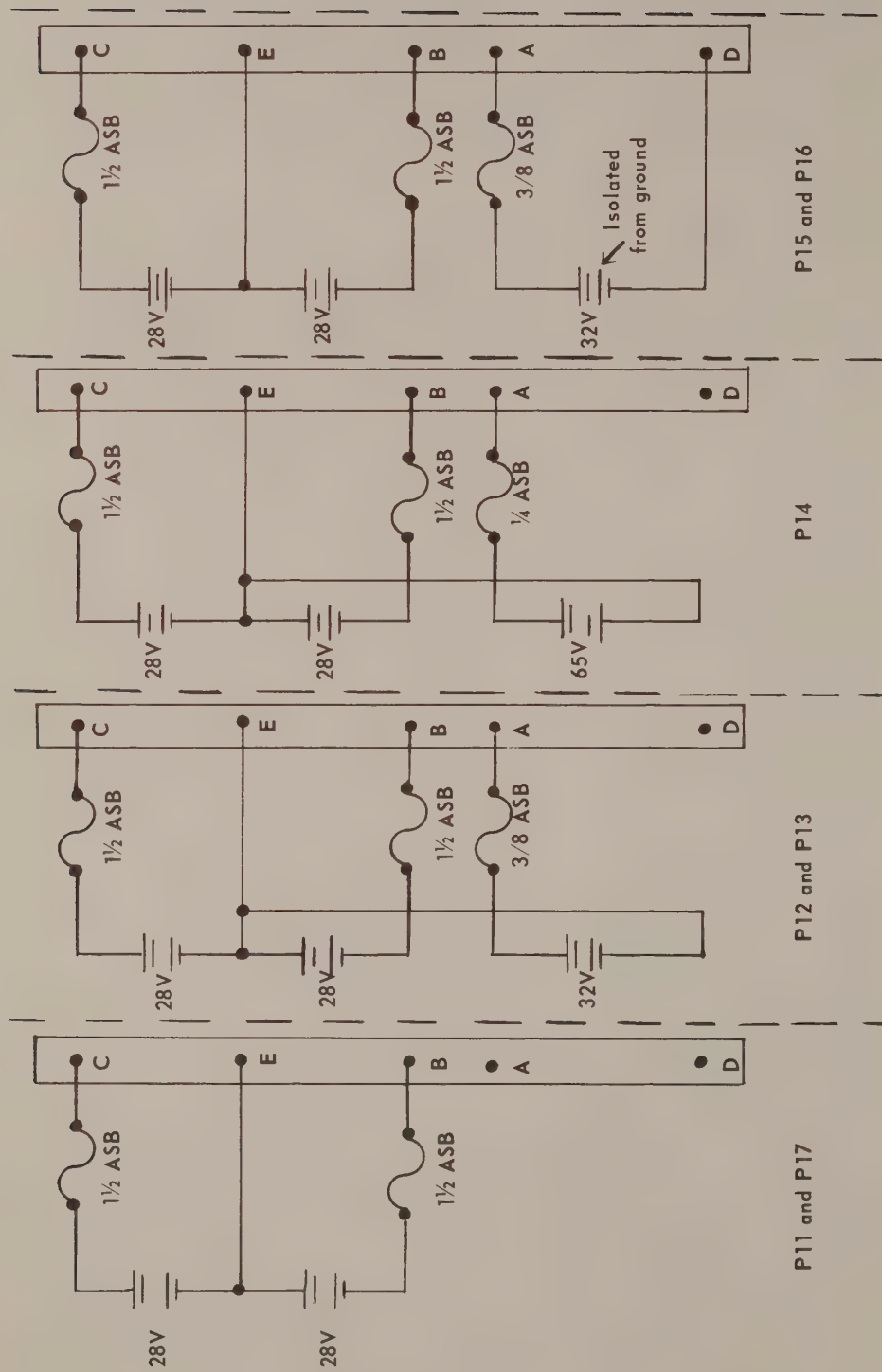
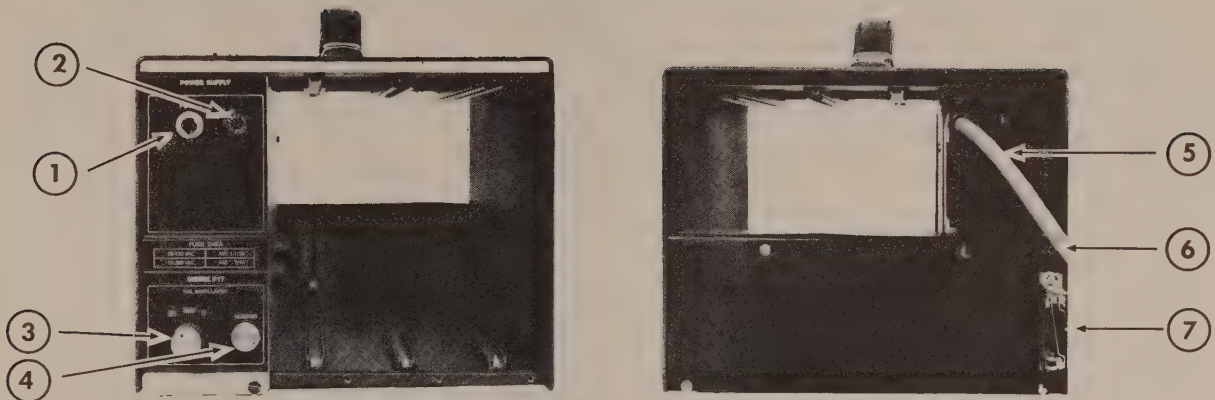


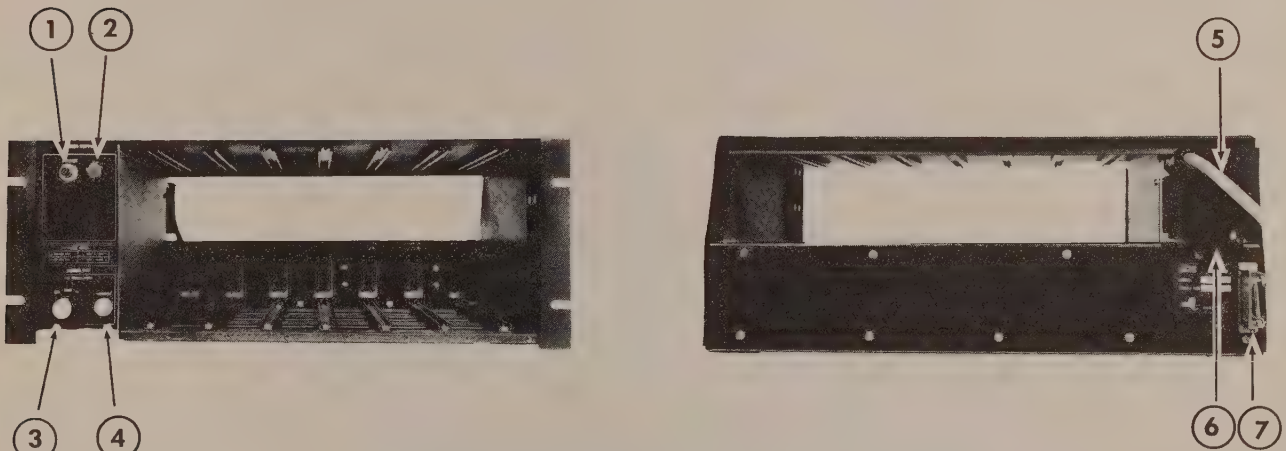
FIGURE 2.3 STANDBY BATTERY CONNECTIONS FOR P SERIES POWER SUPPLIES

SECTION 3

OPERATION



P17 POWER SUPPLY AND S21 PORTABLE CASE



P17 POWER SUPPLY AND S11 RACK MOUNTING CASE

- | | | |
|---|--|--|
| ① | POWER ON/OFF SWITCH WITH POWER LAMP (push ON/push OFF) | |
| ② | POWER FUSE | (3AG, 1½ A for input voltage 90 V – 130 V)
(3AG, ¾ A for input voltage 180 V – 260 V) |
| ③ | CALIBRATION SWITCH | Turns on Calibration Oscillator and energizes Cal Relays |
| ④ | CAL MONITOR | Monitor output of Cal Driver |
| ⑤ | POWER CORD | 3–wire power cord for 115 VAC, 60 Hz |
| ⑥ | GROUND TERMINAL | The power ground and system ground are brought out on this terminal. A permanently attached clip is used to jumper the two grounds together. |
| ⑦ | SERVICE CONNECTOR | Galvo Output connections and external Standby Battery connections |

SECTION 4

4.0 THEORY OF OPERATION

4.1 TRANSFORMER

The power transformer, T1, has a multi-tapped primary which permits, by the proper choice of tap connection, operation over a wide range of input voltages. Normally the transformer is connected for 105-130 V rms. See Primary Power Wiring Diagram for connections.

4.2 POSITIVE 15V REGULATOR

Referring to the +15 volt regulator schematic, note the positive and negative regulator use the same secondary of T1 for input power. This secondary is center-tapped. The output of the transformer is full wave rectified by CR1 and CR2. C1 filters the DC from the rectifier. The regulator is a series regulator with foldback current limiting and remote sensing. The sense leads are connected to the output leads at the mating rack connector. If the supply is used outside of a rackmount, this connection must be made, terminal 15 to 9 and 2 to 8. CR7 and CR3 connect the sense leads to the output leads in the supply to prevent damage if the external connection is not made. Resistors R9, R12 and potentiometer R11 are used to feed back a portion of the output to AR1. AR1 compares the feedback voltage with a reference voltage, generated by temperature compensated zener, CR6. C4 increases the feedback for AC signals, decreasing the ripple and improving the transient response. C5 shunts the zener reference, decreasing the effect of noise voltage generated by the zener. AR1 amplifies the error voltage and applies it to the source of field effect transistor Q3. Q3 is used to couple the output of AR1 to the series pass Darlington connected transistor, Q2, (rear panel mounted). If the output decreases for any reason, the voltage on the wiper of R11 will be below the reference voltage. The output of AR1 will decrease. This results in a smaller gate-to-source voltage for Q3 resulting in an increase in drain current. The increase in drain current flows from the base of Q2, the series pass transistor, causing an increase in collector output current, thereby increasing the output voltage. C6 and C7 connected across the output, increase the transient capabilities of the supply. CR5 clamps the output of the supply in case of an external malfunction tending to pull it negative.

CR4 provides protection for Q2 from reverse bias if C1 is shorted. Q1, Q2, R2, R3, R4 and rear panel mounted resistor R2 are used to provide foldback current limiting. R2 and R3 form a voltage divider to the base of Q2, biasing Q2 off. The output current flows thru current sensing resistor R2 (rear panel mounted). If the output of the supply is overloaded or short circuited, the voltage across R2 increases to a point where Q2 is forward biased causing collector current to flow in Q2. The collector current for Q2 flows from the base of Q1 turning it on. Q1 then supplies current to the drain of Q3 reducing the flow of base current from Q1,

holding the collector current to a safe limit. The output voltage in the case of a severe overload will drop, reducing the voltage across the current sense resistor, R2, required to keep Q2 on. The output current then reduces or "foldsback".

4.3 NEGATIVE 15V REGULATOR

The operation of the Negative 15V regulator is analogous to the +15 V Regulator. Refer to Elementary Diagram for -15V Regulator.

4.4 ± 28 VOLT REGULATOR

Refer to Elementary Diagram for -28 Volt Regulator or +28 Volt Regulator. The operation of the ± 28 Volt Regulator is similar to the operation of the +15 V Regulator except the input rectifier is a full wave bridge and remote sensing is not provided. This regulator is self-contained on one plug-in card. Jumper connections are provided (see note 2 on drawing), to permit operation as either a positive or negative 28 V supply.

4.5 -55 VOLT REGULATOR

Refer to Elementary Diagram for -55 Volt Regulator. The -55 Volt Regulator is self-contained on one plug-in card. CR1, CR2, C1 and C2 form a voltage doubler rectifier and filter. The regulator circuit consists of AR1, Q2 and Q1. Q3 and Q4 provide current limiting. The regulator can be thought of as one inverting amplifier with gain of 3.73. The input is the +15 sense voltage applied to R13. The output is fed back by R11. The junction of R11 and R12 is a virtual ground. AR1 provides gain. An error voltage at its input is amplified and applied to the base of Q2 which provides current amplification for the series pass transistor Q1. Q1 is protected against reverse bias, if the input filter is shorted, by CR3. CR7 clamps the output to ground for output malfunctions tending to pull the output positive. C5 improves the output transient response. C4 increases the feedback for AC reducing output ripple and noise.

R8 provides current sensing. In case of overloads or short circuits, the voltage developed across it will turn on Q4 and then Q3 which tends to turn off Q2, thereby holding the current thru Q1 to a safe value. If the load demands more current, the output voltage will drop, decreasing the voltage across R7 which increases the effect of the voltage across R8. Less voltage across R8 (less current thru it) will be required to keep Q4 on and the output current will decrease or "foldback".

Both +15VDC and -15VDC are required for proper operation of this regulator. This card plugs into the same spot as the ± 28 V card, consequently no power supply has both regulators.

4.6 CAL OSCILLATOR

Refer to elementary diagram for Cal System. AR1, R1, R2, C1, C3 form a 2-pole low-pass filter with 90° phase shift and 3 dB attenuation at 1000 Hz. AR2, R3 and C5 form an integrator with phase shift of 270° and gain slightly more than 3 dB at 1000 Hz. The two stages then oscillate at 1000 Hz. CR1 and CR3 provide amplitude stability since they clip the sine wave at $\pm 6.2\text{V}$. The clipped sine wave is filtered by AR1 and AR2 and is applied as the input to AR3.

AR3 is connected as an inverting amplifier with gain less than unity. The actual gain is adjusted by R17. The output level can be set between 0.707V rms to 1V rms by adjusting R17. AR3 is a power driver and permits 50 ohm loads.

5.0 MAINTENANCE AND CALIBRATION

5.1 GENERAL

Access to the circuitry is obtained by removing the two side panel screws from the right side panel, and sliding the panel towards the rear and the two retaining screws at each end of the left side panel. If either a ± 28 V regulator card or -55 V regulator card is present, it may be removed by removing the two screws at the bottom of the printed circuit cards and the two screws that go thru the top rail into the heatsink bar at the top of the card. Do not attempt to remove the top two screws (slots filled with epoxy) or any screws in the bottom rail. The Cal Oscillator circuitry is exposed by pushing the cal oscillator card toward the transformer until the four rubber grommets clear the studs and then pull the card to the left.

5.2 CALIBRATION

5.2.1 CAL OSCILLATOR AMPLITUDE

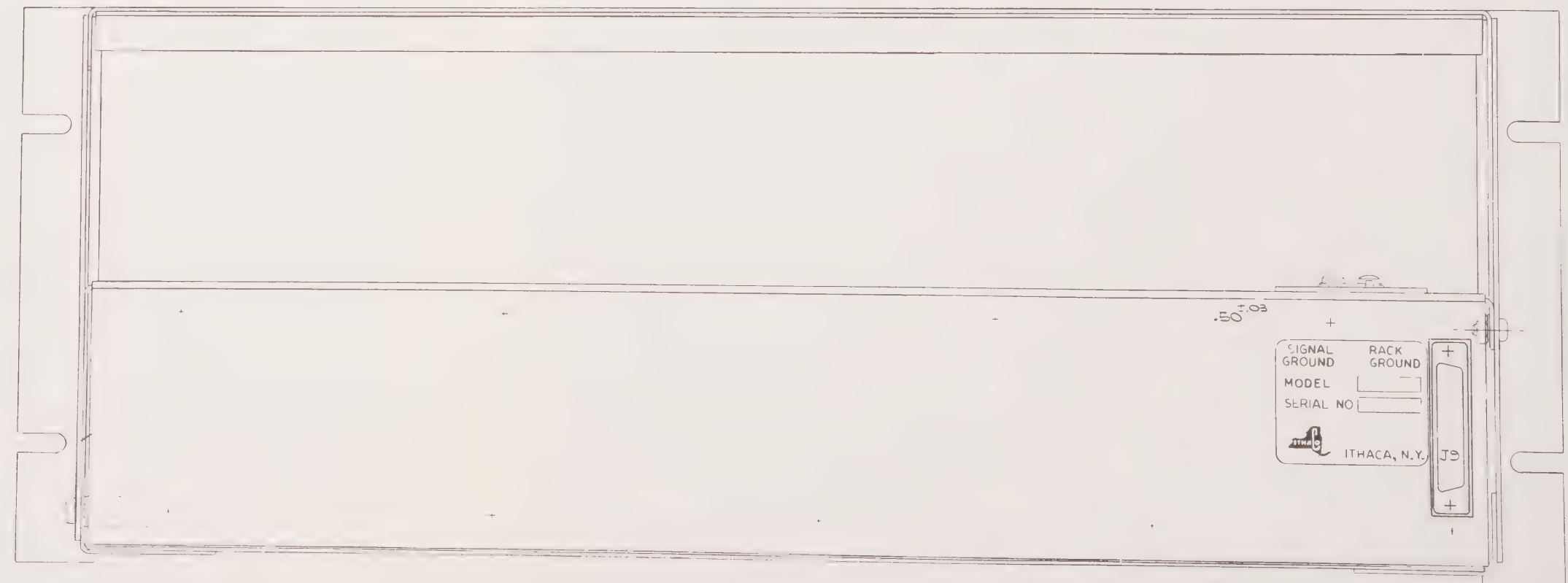
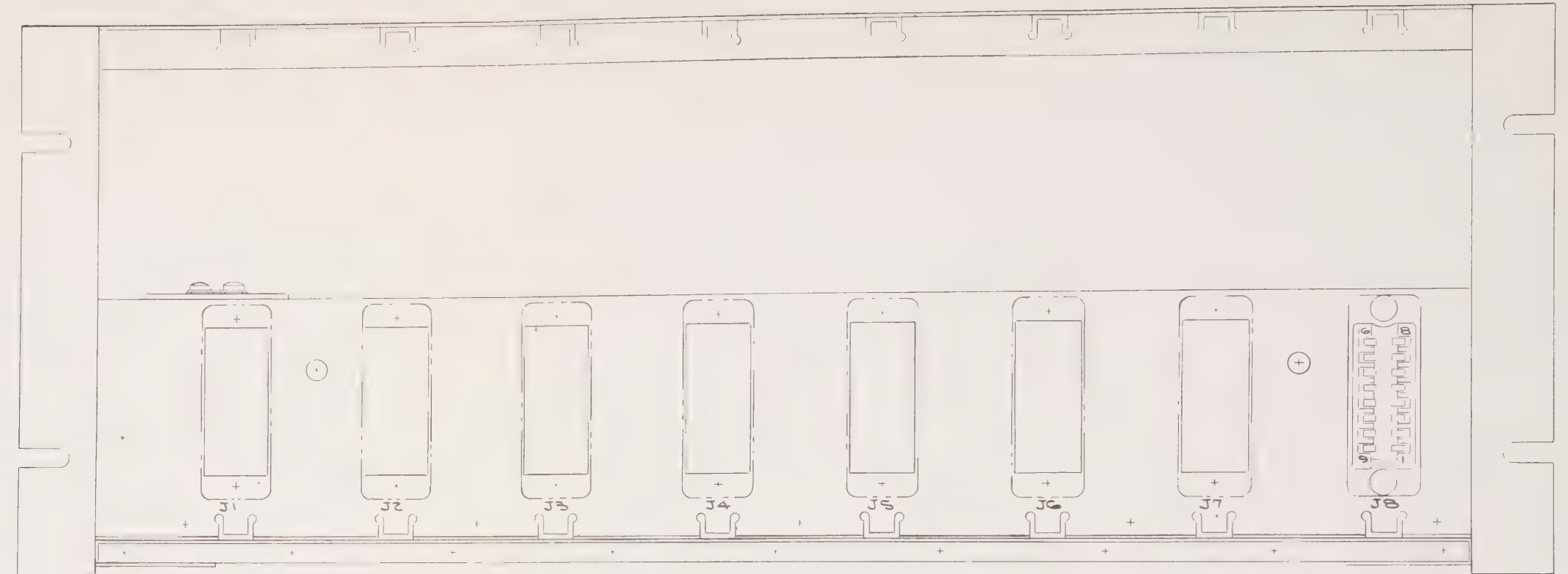
Remove left side panel. With Operate/Calibrate switch in Calibrate, monitor the cal signal. Adjust the amplitude to the required value with R17 (CW increases amplitude).

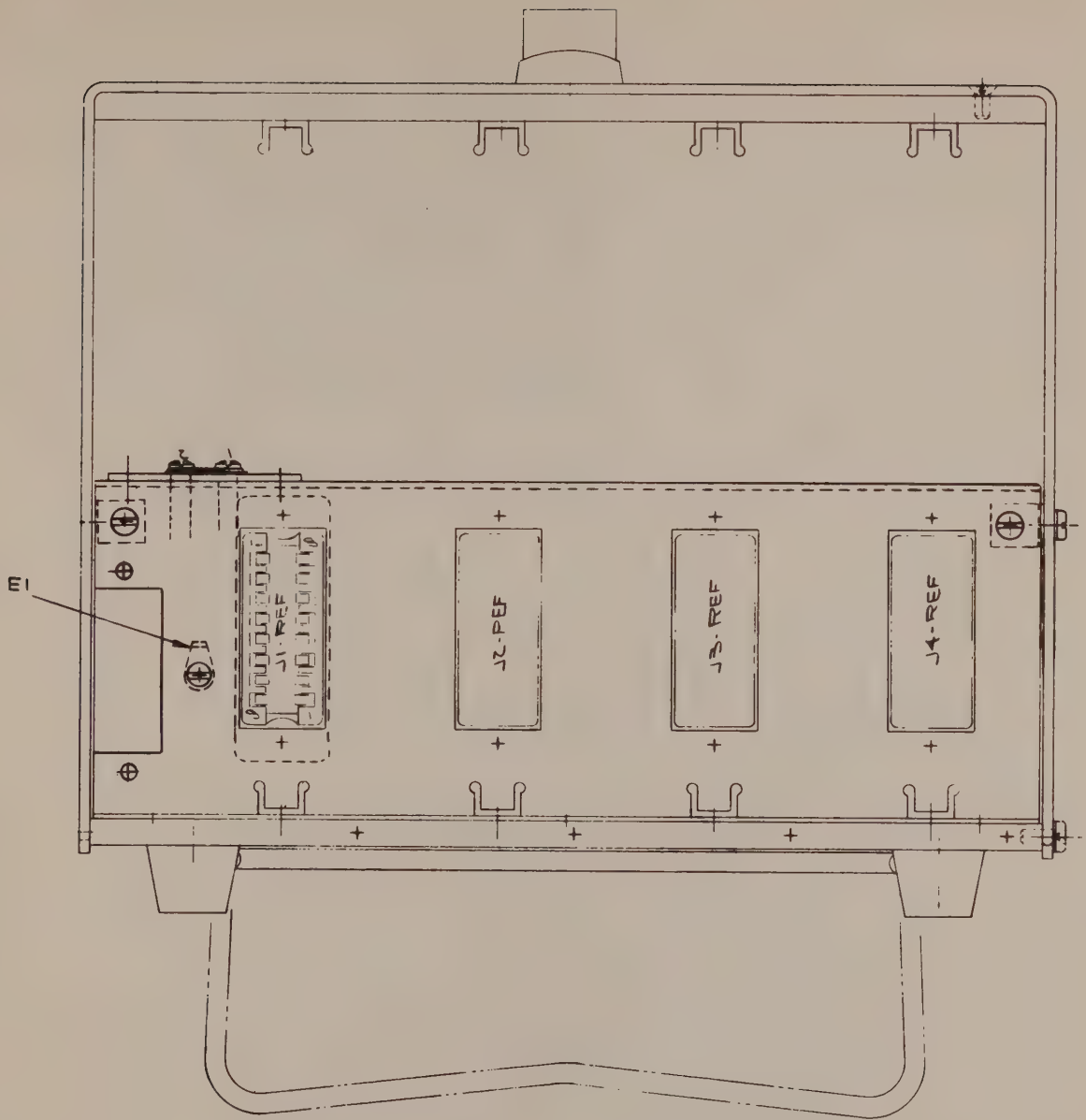
5.2.2 -15 V AMPLITUDE

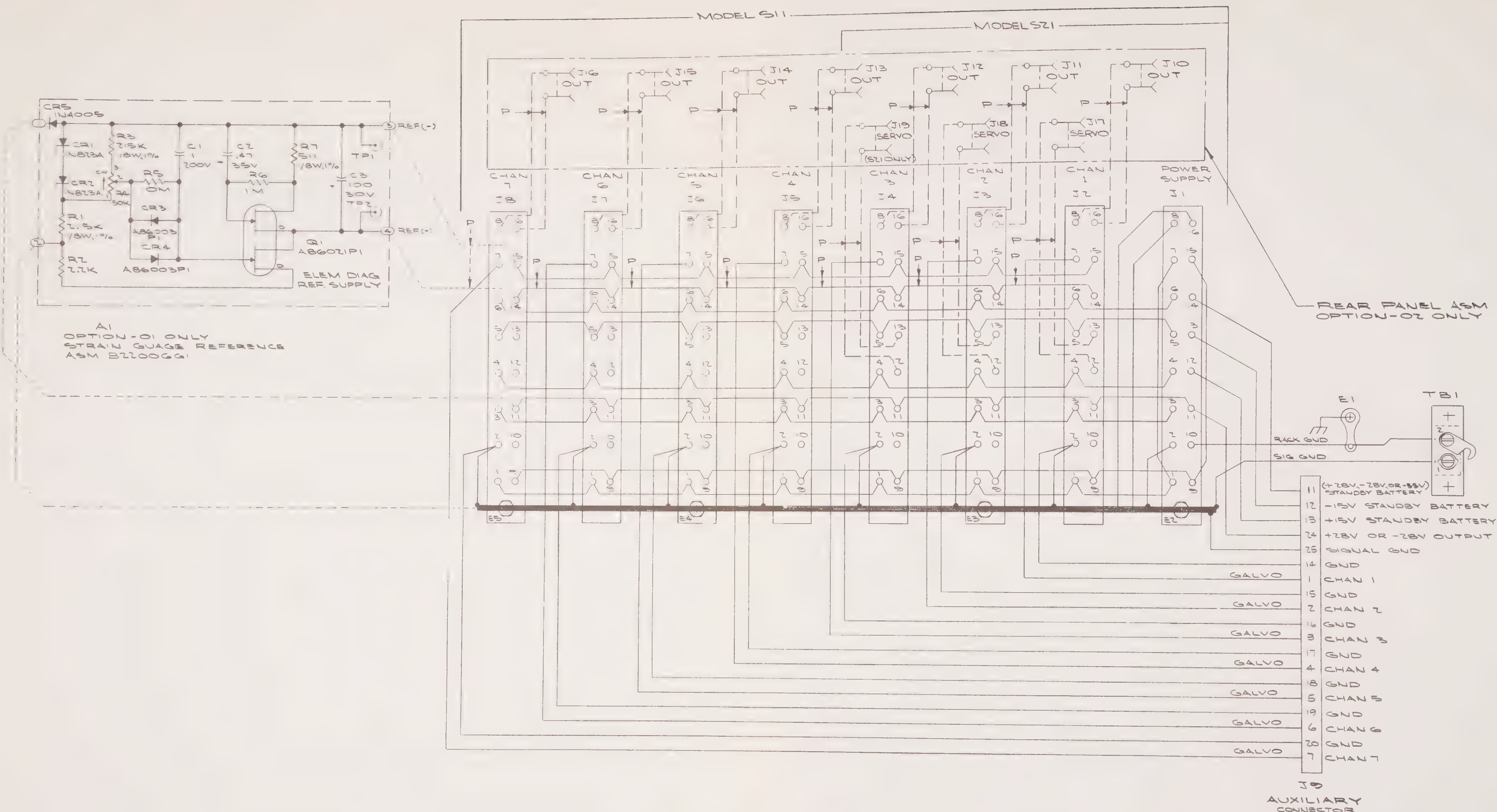
Remove left side panel. Use a suitable adapter which connects the sense leads to the corresponding output. (See section 2.4). Adjust R23 for -15 V (CW increases amplitude).

5.2.3 $+15$ V AMPLITUDE

Remove left side panel, and ± 28 V Regulator card or -55 V Regulator card if present. Use a suitable adapter which connects the sense leads to the corresponding output (see Section 2.4). Adjust R11 for $+15$ V (CW increases amplitude).

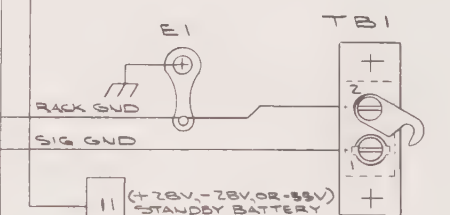






A1
OPTION -01 ONLY
STRAIN GAUGE REFERENCE
ASM B2200GG1

REAR PANEL ASM
OPTION-02 ONLY



J9
AUXILIARY
CONNECTOR

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
RESISTOR VALUES ARE IN OHMS.
RESISTORS ARE 1/4W, CARBON
COMPOSITION, 5% TOL.
CAPACITOR VALUES ARE IN
MICROFARADS.

2. J1 THRU J8 ARE AMPHENOL #26-4200-16S,
J9 IS CANNON DBM-28D

8 (461 TAPE OUT)	16 (461 TAPE GND)	8 +15V SENSE RET	16 +28V, -28V OR -55V RET.
7 GALVO OUT	15 REF(-) OPTION -01 ONLY	7 -15V SENSE	15 +15V SENSE
6 CAL RLY PWR	14 REF(+) OPTION -01 ONLY	6 CAL RLY PWR	14 +28V, -28V OR -55V STANDBY BATT.
5 CAL RLY RET	13 (461 SERVO GND)	5 CAL RLY RET	13 -15V STBY BATT.
4 -55VDC	12 (461 SERVO OUT)	4 -55VDC	12 +15V STBY BATT.
3 CAL OSC	11 PREAMP PWR	3 CAL OSC	11 PREAMP PWR
2 SIGNAL GND	10	2 SIGNAL GND	10 POWER GND
1 -15VDC	9 +15VDC	1 -15VDC	9 +15VDC
J2 THRU J8 PIN ASSIGNMENT		J1 PIN ASSIGNMENT	
PIN	FUNCTION	PIN	FUNCTION

FIGURE 6.3
S11 - S21 SERIES CASE
WIRING DIAGRAM

MODIFICATION INSTRUCTION
MOUNTING FRAME
OPTION -01

SCOPE: THIS DOCUMENT IS ESTABLISHED AS A SOURCE OF INFORMATION FOR THE PURPOSE OF INCLUDING AN OPTION -01 IN A MODEL S11 RACK MOUNTING FRAME (ASM. DWG. NO. D41106G1) OR A MODEL S21 PORTABLE MOUNTING FRAME (ASM. DWG. NO. C31521G1).

DEFINITION: OPTION 01 CONSTITUTES THE ADDITION OF A REAR PANEL MOUNTED STRAIN GAUGE REFERENCE CARD TO A S11 OR S21 MOUNTING FRAME.

GENERAL: THE FOLLOWING TEXT CONTAINS A LIST OF PARTS TO BE ADDED TO THE UNIT, A LIST OF INSTRUCTIONS, A VIEW SHOWING THE AREA OF CHANGE AND A RUNNING LIST.

REFERENCE DWGS:

D41106G1	ASM RACK MOUNTING FRAME S11
C31521G1	ASM PORTABLE MOUNTING FRAME S21
D41084	ELEM. DIAG. MOUNTING FRAME
B22006G1	ASM, REFERENCE SUPPLY

MODIFICATION INSTRUCTION
MOUNTING FRAME
OPTION -01

LIST OF ADDITIONS TO THE
FINAL MODEL ASSEMBLY

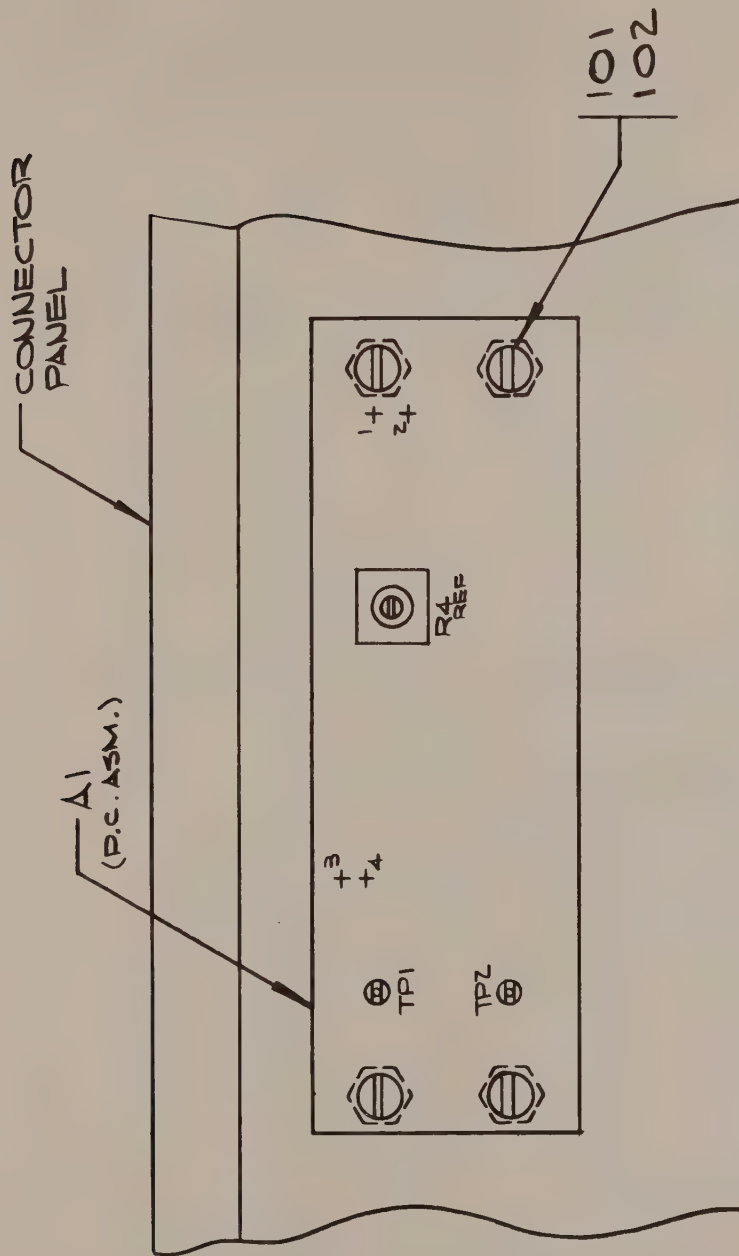
<u>ITEM</u>	<u>IDENTIFICATION NO.</u>	<u>DESCRIPTION</u>	<u>QTY</u>
A1	B22006G1	ASM, REF. SUPPLY CARD	1
101	812811408	SCR. PAN HD. SLOTTED #4-40x1/4"LG.	4
102	812841114	LOCKWASHER INT. TH. #4	4
103	A10447P1	LABEL (SEE INSTRUCTION NO. 6)	1

MODIFICATION INSTRUCTION
MOUNTING FRAME
OPTION -01

INSTRUCTIONS

1. PULL FROM STOCK A MODEL S11 RACK MOUNTING FRAME (ASM DWG. NO. D41106G1) OR A MODEL S21 PORTABLE MOUNTING FRAME (ASM DWG. NO. C31521G1).
2. REMOVE REAR PANEL
3. ATTACH A1 CARD (ASM DWG. NO. B22006G1) TO FOUR SPACER PROVIDED USING HARDWARE ITEMS 101 & 102.
4. ADD FOUR WIRES PER ATTACHED RUNNING LIST (FOR ELEM DIAG SEE D41084).
5. INSPECT AND TEST FOR THIS ADDITION AND REPLACE REAR PANEL.
6. REPLACE REAR LABEL WITH A NEW LABEL REDESIGNATING UNIT AS MODEL S11-01 OR S21-01.

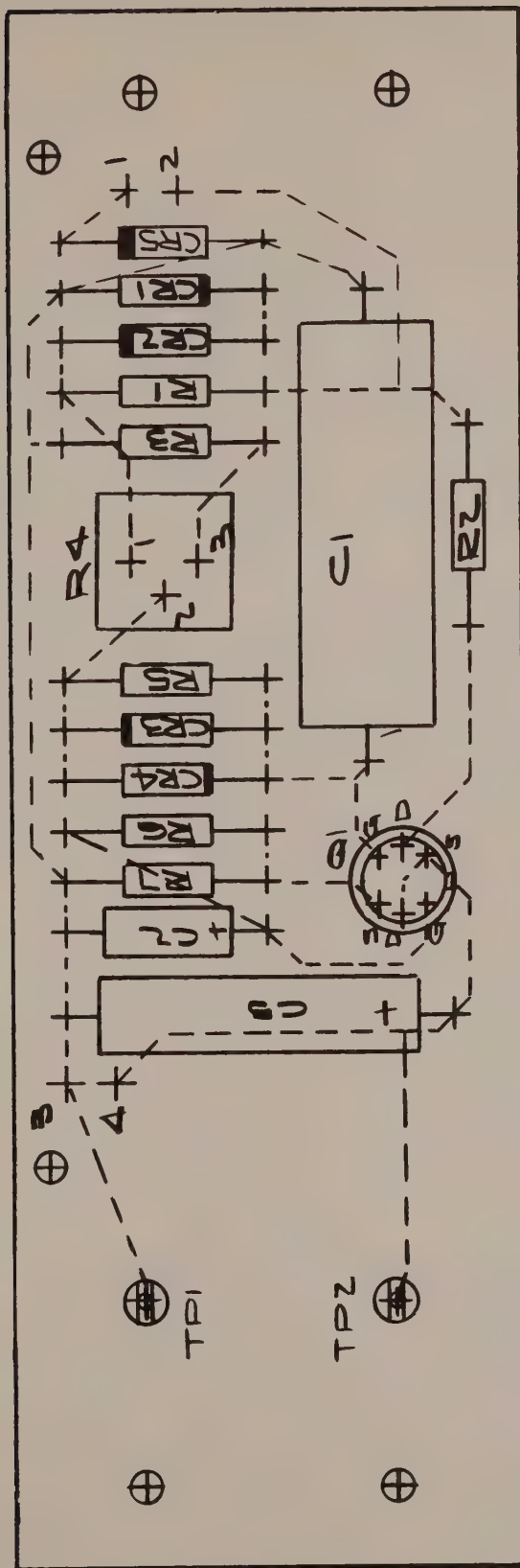
MOD. INST.
MOUNTING FRAME
OPTION -01



RACK REAR VIEW
(REAR PANEL REMOVED)

MOUNTING FRAME OPTION -01

WIRE NO	AWG	COLOR BODY	1ST TRACER	CABLE ROUTING	FROM	TO	FUNC	LGTH
FOR MODEL S11-01 WIRING SEE BELOW:								
1	24	WHT			A1-1	J8-11	INPUT	
2	24	BLK			A1-2	J8-GND BUSS	GND	
3A	24	WHT	VIO		A1-3	J8-15	-REF	
3B	24	WHT	RED		A1-4	J8-14	+REF	
FOR MODEL S21-01 WIRING SEE BELOW:								
1	24	WHT			A1-1	J4-11	INPUT	
2	24	BLK			A1-2	J4-GND BUSS	GND	
3A	24	WHT	VIO		A1-3	J4-15	-REF	
3B	24	WHT	RED		A1-4	J4-14	+REF	
NOTE :								
1. A & B INDICATES TWISTED PAIR								



ASSEMBLY INSTRUCTIONS
MOUNTING FRAME OPTION-02

SCOPE: THIS DOCUMENT IS ESTABLISHED AS A SOURCE OF INFORMATION FOR THE PURPOSE OF INCLUDING AN OPTION IN A MODEL S11 RACK MOUNTING FRAME (ASM DWG. NO. D41106G1) OR A MODEL S21 PORTABLE MOUNTING FRAME (ASM DWG. NO. C31521G1).

DEFINITION: OPTION -02 CONSTITUTES THE ADDITION OF REAR PANEL MOUNTED BNC CONNECTORS FOR CONNECTION OF OUTPUT AND SERVO OUTPUT OF THE MODEL 461 AMPLIFIER.

GENERAL: CONTAINED HEREIN IS A LIST OF ITEMS TO BE DELETED FROM THE UNIT, A LIST OF REPLACEMENT ITEMS, AND A LIST OF INSTRUCTIONS.

REFERENCE DWG'S:

- D41106G1, ASM, RACK MOUNTING FRAME MODEL S11
- C31521G1, ASM, PORTABLE MOUNTING FRAME MODEL S21
- D41084 ELEM DIAG, MOUNTING FRAME
- C31729G1 ASM, REAR PANEL (S11-02)
- C31728 REAR PANEL (S11-02)
- A11453 R.L., REAR PANEL ASM (S11-02)
- C31731G1 ASM, REAR PANEL (S21-02)
- C31730 REAR PANEL (S21-02)
- B22185 ANGLE BRACKET (S21-02)
- A11454 R.L., REAR PANEL ASM (S21-02)

ASSEMBLY INSTRUCTIONS

MOUNTING FRAME OPTION-02

LIST OF ITEMS TO BE DELETED

FROM MODEL S11
ASM DWG. NO. D41106G1

<u>ITEM</u>	<u>IDENT</u>	<u>DESCRIPTION</u>	<u>QTY</u>
8	C31523P1	PANEL, REAR	1
10	A10447P1	LABEL	1

FROM MODEL S21
ASM DWG NO. C31521G1

12	B22018P1	PANEL, REAR	1
13	A10447P1	LABEL	1

LIST OF REPLACEMENT ITEMS

TO MODEL S11
ASM DWG NO. D41106G1

8	C31729G1	ASM, REAR PANEL	1
10	A10447P1	LABEL	1

TO MODEL S21
ASM DWG NO. C31521G1

12	C31731G1	ASM, REAR PANEL	1
13	A10447P1	LABEL	1

ASSEMBLY INSTRUCTIONS
MOUNTING FRAME OPTION-02

INSTRUCTIONS

FOR MODEL S11 ASM DWG NO. D41106G1
(FOR ASSEMBLY VIEWS SEE D41106&C31729)

- A. REMOVE REAR PANEL (C31525P1) AND REPLACE WITH REAR PANEL ASSEMBLY DWG. NO. C31729G1.
- B. WIRE PER RUNNING LIST A11453 "TO" END.
- C. REPLACE REAR LABEL (A10447P1) WITH NEW LABEL RE DESIGNATING UNIT AS MODEL S11-02.

FOR MODEL S21 ASM DWG NO. C31521G1
(FOR ASSEMBLY VIEW SEE C31521&C31731)

- A. REMOVE REAR PANEL (B22018P1) AND REPLACE WITH REAR PANEL ASSEMBLY DWG. NO. C31731G1.
- B. WIRE PER RUNNING LIST A11454 "TO" END.
- C. REPLACE REAR LABEL (A10447P1) WITH NEW LABEL RE DESIGNATING UNIT AS MODEL S21-02.

ASSEMBLY INSTRUCTIONS
MODEL S11, S21 MOUNTING FRAME
WITH AMPLIFIER REMOTE GAIN CONTROL OPTION 19

- SCOPE: THIS DOCUMENT IS ESTABLISHED AS A SOURCE OF OF INFORMATION FOR THE PURPOSE OF ADDING AN OPTION TO A MODEL S11, S21 or S30 MOUNTING FRAME. THIS OPTION IS FOR USE WITH MODEL 450 SERIES AMPLIFIERS WITH 5dB MANUAL/REMOTE GAIN CONTROL OPTION 26 AND 10dB MANUAL/REMOTE GAIN CONTROL OPTION 19.
- DEFINITION: THE MOUNTING FRAME WITH OPTION 19 DIFFERS FROM THE STANDARD IN THAT THE STANDARD WIRING (EXCEPT +15V, -15V, -55V AND PREAMP POWER AND THE PRIMARY S30 WIRING) IS REPLACED BY WIRING THRU WHICH THE GAIN OF A MODEL 450 SERIES AMPLIFIER WITH OPTION 19 OR OPTION 26 MAY BE CONTROLLED FROM A REMOTELY LOCATED MODEL 450C1 (10dB) OR MODEL 450C2 (5dB) GAIN CONTROL UNIT (VIA REAR PANEL AUXILIARY CONNECTOR) OR MAY BE CONTROLLED FROM A MODEL 450C1 OR 450C2 PLUGGED INTO THE MOUNTING FRAME WITH THE AMPLIFIERS. FOR CONNECTION OF A REMOTELY LOCATED MODEL 450C1 OR 450C2 A MODEL 450V2 CONNECTION CABLE MAY BE USED.
- GENERAL: THE MOUNTING FRAME WITH OPTION 19 IS MECHANICALLY IDENTICAL WITH THE STANDARD, ONLY THE WIRING DIFFERS. FOR INSTRUCTIONS, SEE SHEET 2.

ASSEMBLY INSTRUCTIONS
MODEL S11, S21 MOUNTING FRAME
WITH AMPLIFIER REMOTE GAIN CONTROL OPTION 19

INSTRUCTIONS

MODEL S11 (ASM DWG. NO. D41106 G1)

- A.) ASSEMBLE ALL HARDWARE USING DOCUMENTATION FOR A MODEL S11 MOUNTING FRAME.
- B.) WIRE PER R.L. A11503. FOR ELEM DIAG SEE D41434.
- C.) ON REAR PANEL SERIAL LABEL TYPE-IN MODEL NO. S11-19 AND SERIAL NO.

MODEL S21 (ASM DWG. NO. C31521 G1)

- A.) ASSEMBLE ALL HARDWARE USING DOCUMENTATION FOR A MODEL S21 MOUNTING FRAME.
- B.) WIRE PER R.L. A11504. FOR ELEM DIAG SEE D41434.
- C.) ON REAR PANEL SERIAL LABEL TYP-IN MODEL NO. S21-19 AND SERIAL NO.

MODEL S30 (ASM DWG NO. ~~C31789~~ G1)

- A.) ASSEMBLE ALL HARDWARE USING DOCUMENTATION FOR A MODEL S30 MOUNTING FRAME.
- B.) WIRE PER R.L. A11505. FOR ELEM DIAG SEE D41435.
- C.) ON REAR PANEL SERIAL LABEL TYPE IN MODEL NO. S30-19 AND SERIAL NO.

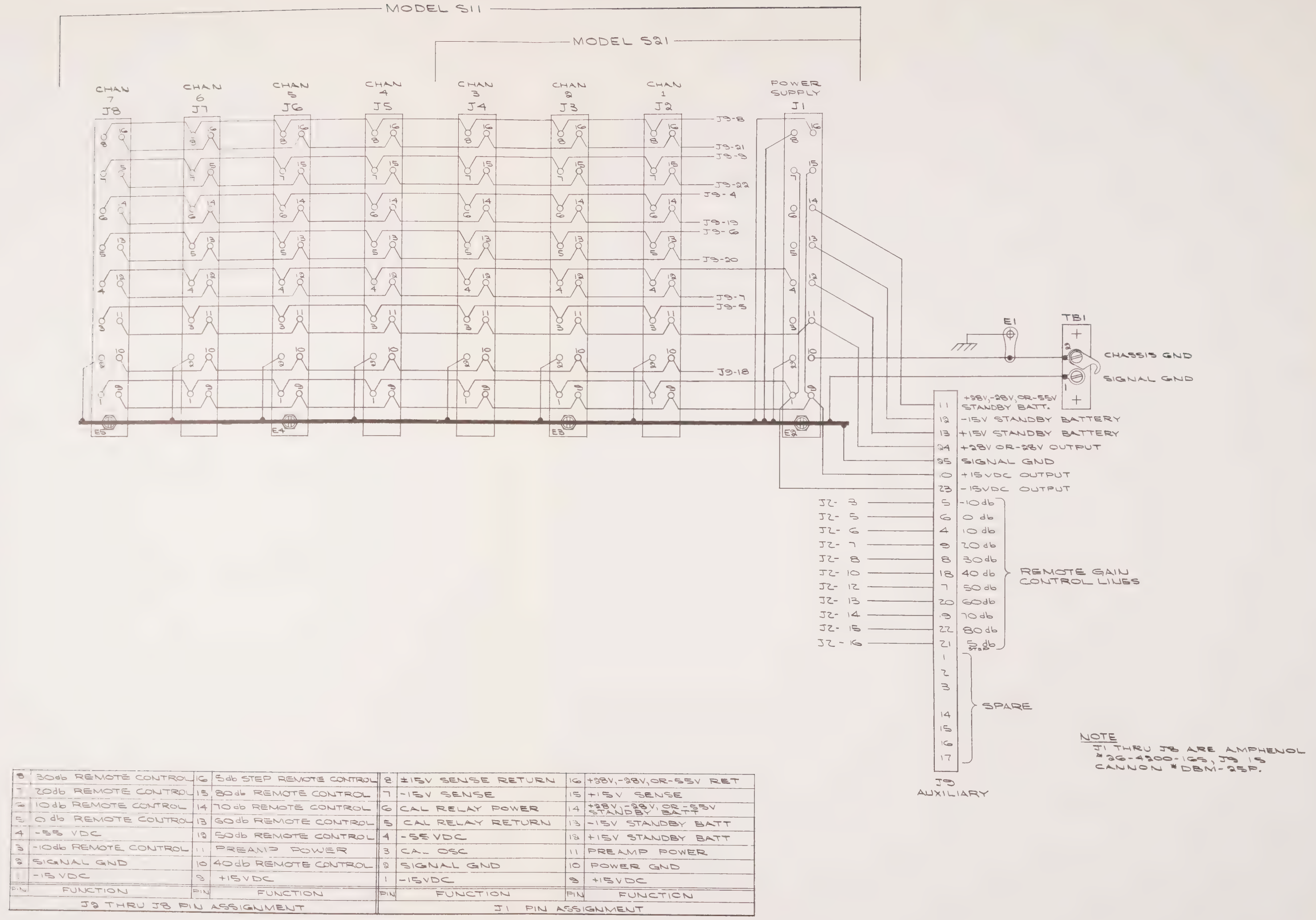


FIGURE 6.8
S SERIES CASE - OPTION 19
WIRING DIAGRAM

ASSEMBLY INSTRUCTIONS
MODEL S11, S21 MOUNTING FRAME
WITH AMPLIFIER STATUS READOUT OPTION 23

SCOPE: This document is established as a source of information for the purpose of adding an option to a model S11, S21, or S30 Mounting Frame. This Option is for use with Model 450 series Amplifiers with Status Readout Options 20 thru 23.

DEFINITION: The Mounting Frame with option 23 differs from the standard in that the standard wiring (except +15V, -15V, and -55V and the primary S30 wiring) is replaced by wiring through which the status of the Amplifiers 10dB Gain Switch, 1dB Gain Switch & LFRO Switch, are brought out encoded in a Binary format in 11 lines plus a Strobe for each channel. For Binary coding format see A11475 sheet 17.

GENERAL: The Mounting Frame with option 23 is mechanically identical with the standard, only the wiring differs. For instructions, see sheet 2.

ASSEMBLY INSTRUCTIONS
MODEL S11, S21 MOUNTING FRAME
WITH AMPLIFIER STATUS READOUT OPTION 23

INSTRUCTIONS

MODEL S11 (ASM DWG. NO. D41106 G1)

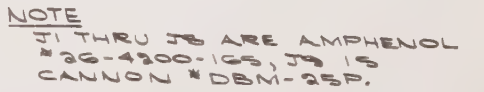
- A.) Assemble all hardware using documentation for a Model S11 Mounting Frame.
- B.) Wire per RL A11480. For Elem Diag. see D41368.
- C.) On Rear Panel serial label type-in Model No. S11-23 and serial No.

MODEL S21 (ASM, DWG NO. C31521 G1)

- A.) Assemble all hardware using documentation for a Model S21 Mounting Frame.
- B.) Wire per RL A11481. For Elem Diag. see D41368.
- C.) On Rear Panel serial label type-in Model No. S21-23 and serial No.

MODEL S30 (ASM DWG NO. ~~C31789~~ G1)

- A.) Assemble all hardware using documentation for a Model S30 Mounting Frame.
- B.) Wire per RL A11482. For Elem Diag. see D41370.
- C.) On Rear Panel serial label type-in Model No. S30-23 and serial No.



ITHACO DWG D41368, SH 1, 12/73

PI PIN ASSIGNMENT

PIN NO.	FUNCTION	USED IN MODEL						
		P11	P12	P13	P14	P17	P15	P16
1	-15V	X	X	X	X	X	X	X
2	SIGNAL GND	X	X	X	X	X	X	X
3	CAL (OUTPUT)			X		X		X
4	-35V				X			
5	CAL RELAY RET			X		X		X
6	CAL RELAY PWR			X		X		X
7	-15V SENSE	X	X	X	X	X	X	X
8	-15V RET SENSE	X	X	X	X	X	X	X
9	+15V	X	X	X	X	X	X	X
10	CHASSIS (RACK) GND	X	X	X	X	X	X	X
11	PREAMP PWR		-25V	-25V			-25V	-25V
12	+15V STANDBY BATT	X	X	X	X	X	X	X
13	-15V STANDBY BATT	X	X	X	X	X	X	X
14	PREAMP PWR STANDBY BATT		X	X	X		X	X
15	+15V SENSE	X	X	X	X	X	X	X
16	PREAMP PWR -15V RET	X	X	X	X	X	X	X

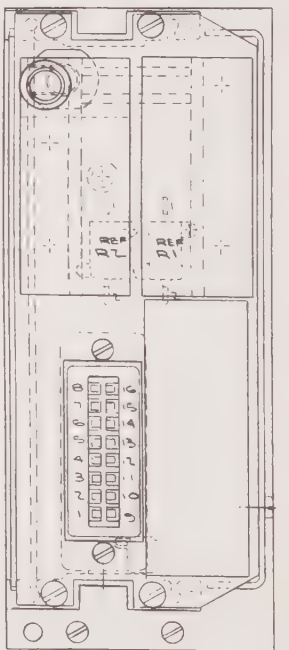
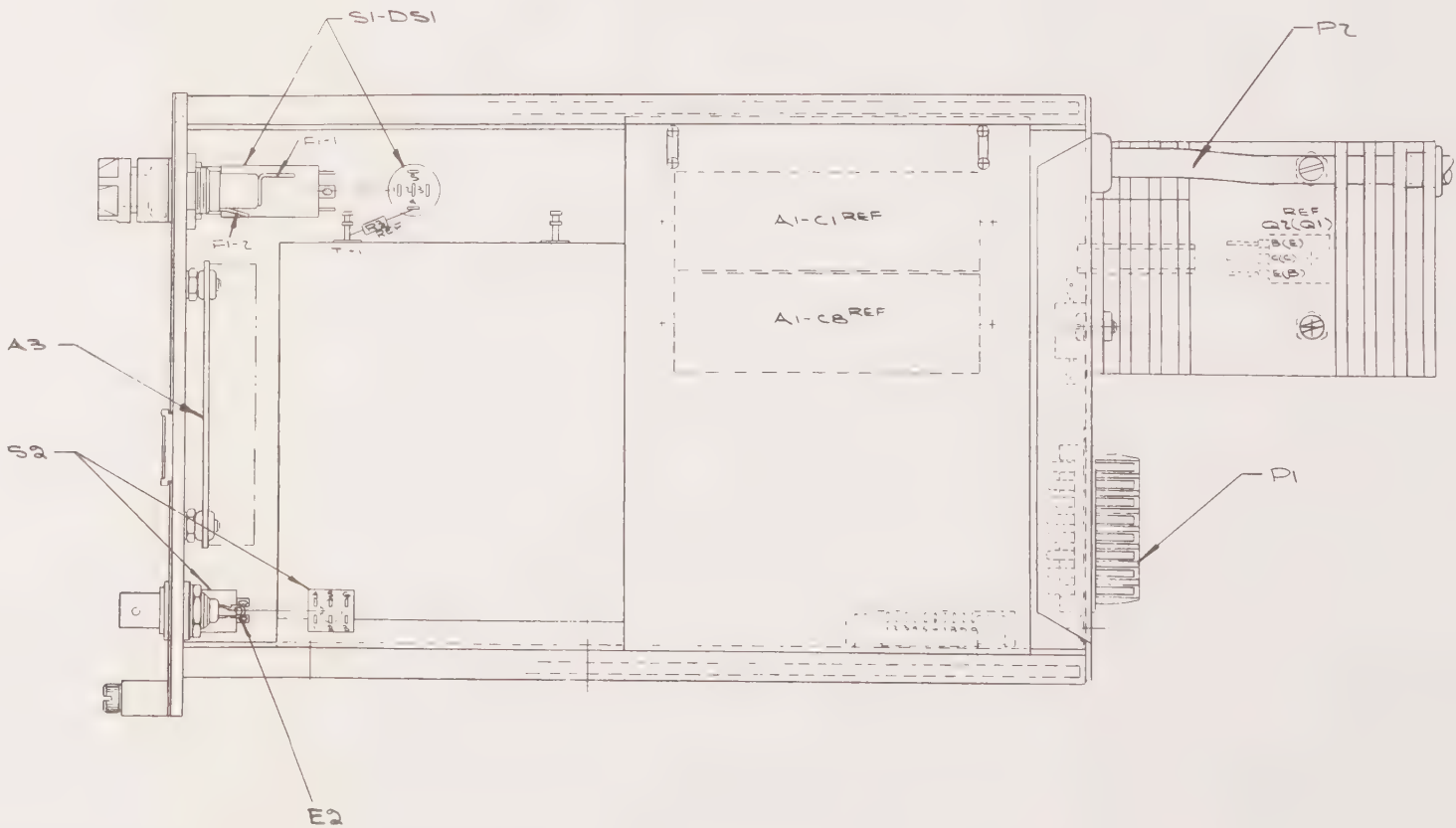
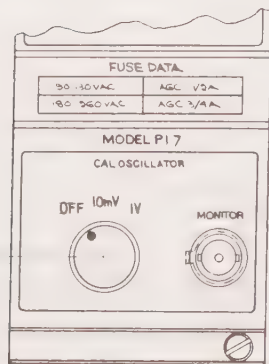
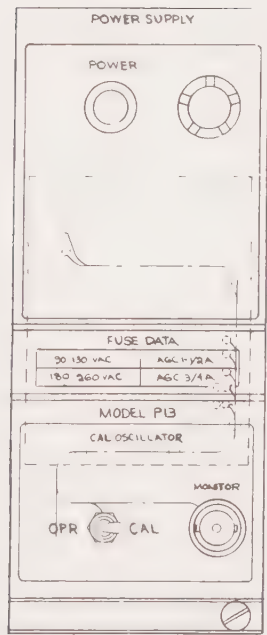
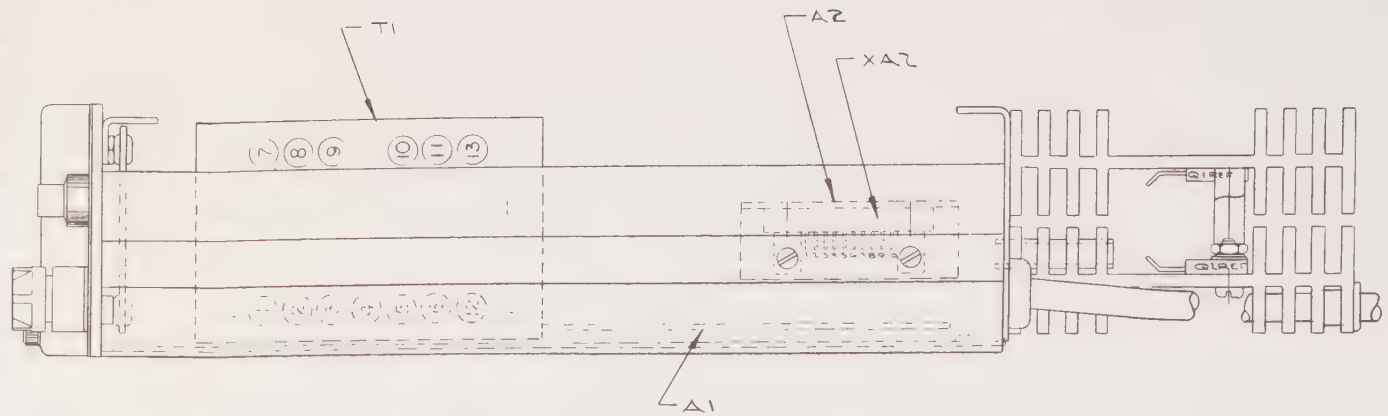
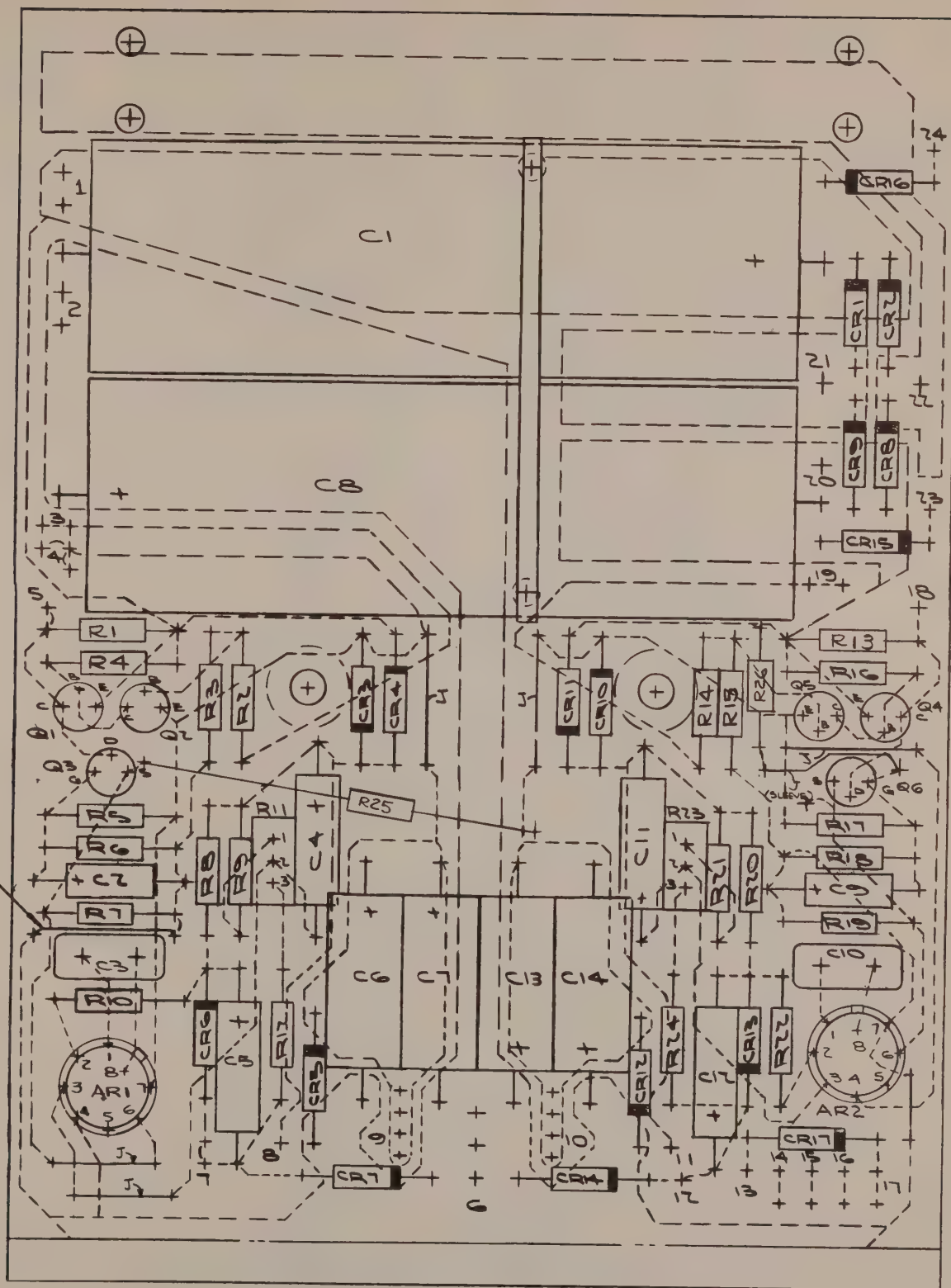


FIGURE 6.11
P SERIES POWER SUPPLY
ASSEMBLY





THACO DWG C31408, SH 3, REV K, 5/75

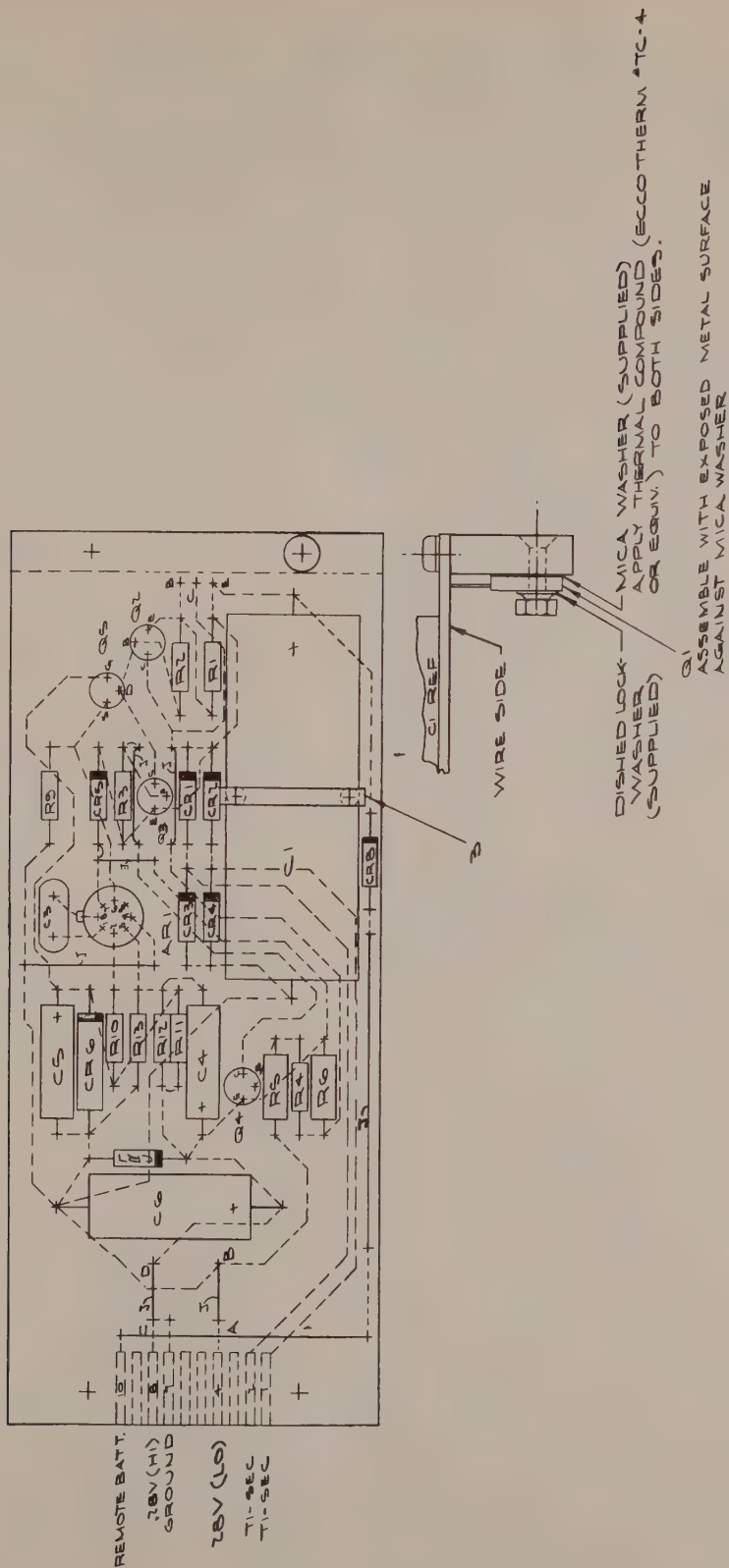


FIGURE 6.16 P SERIES POWER SUPPLY - ± 28 VOLT REGULATOR - ASSEMBLY

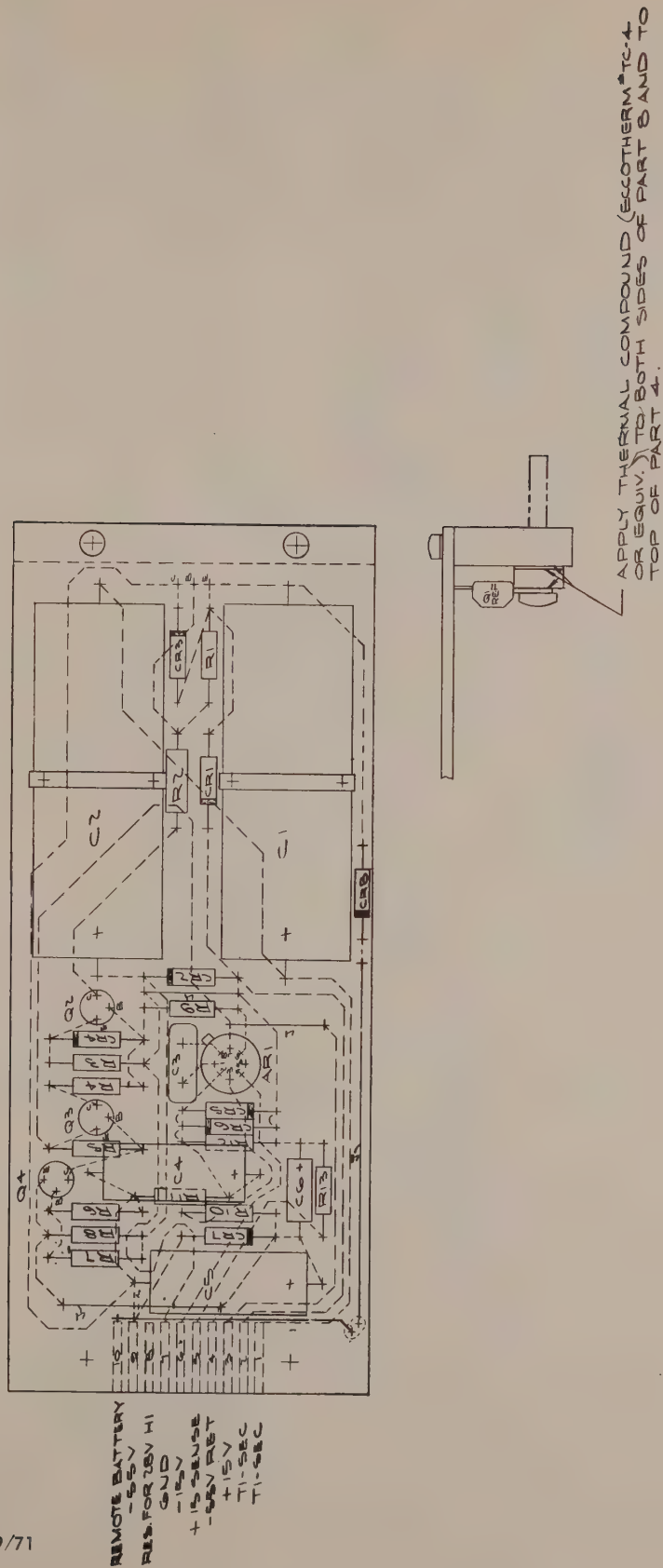
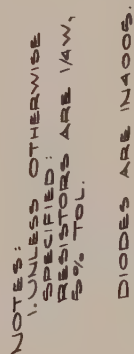
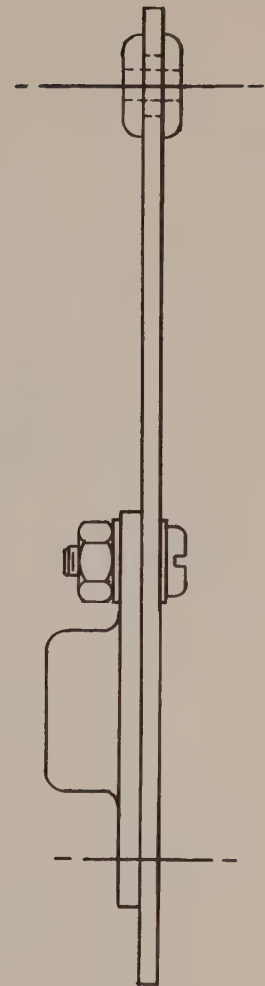
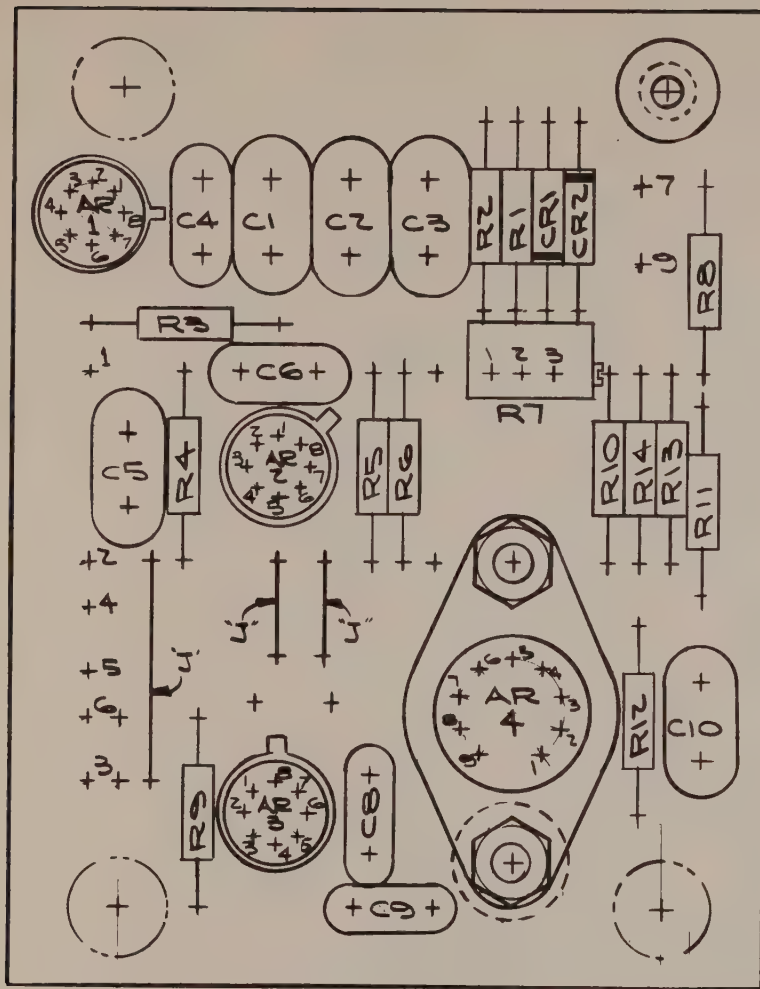


FIGURE 6.18 P SERIES POWER SUPPLY -55 VOLT REGULATOR - ASSEMBLY



ITHACO DWG C31408, SH 5, REV E, 4/72



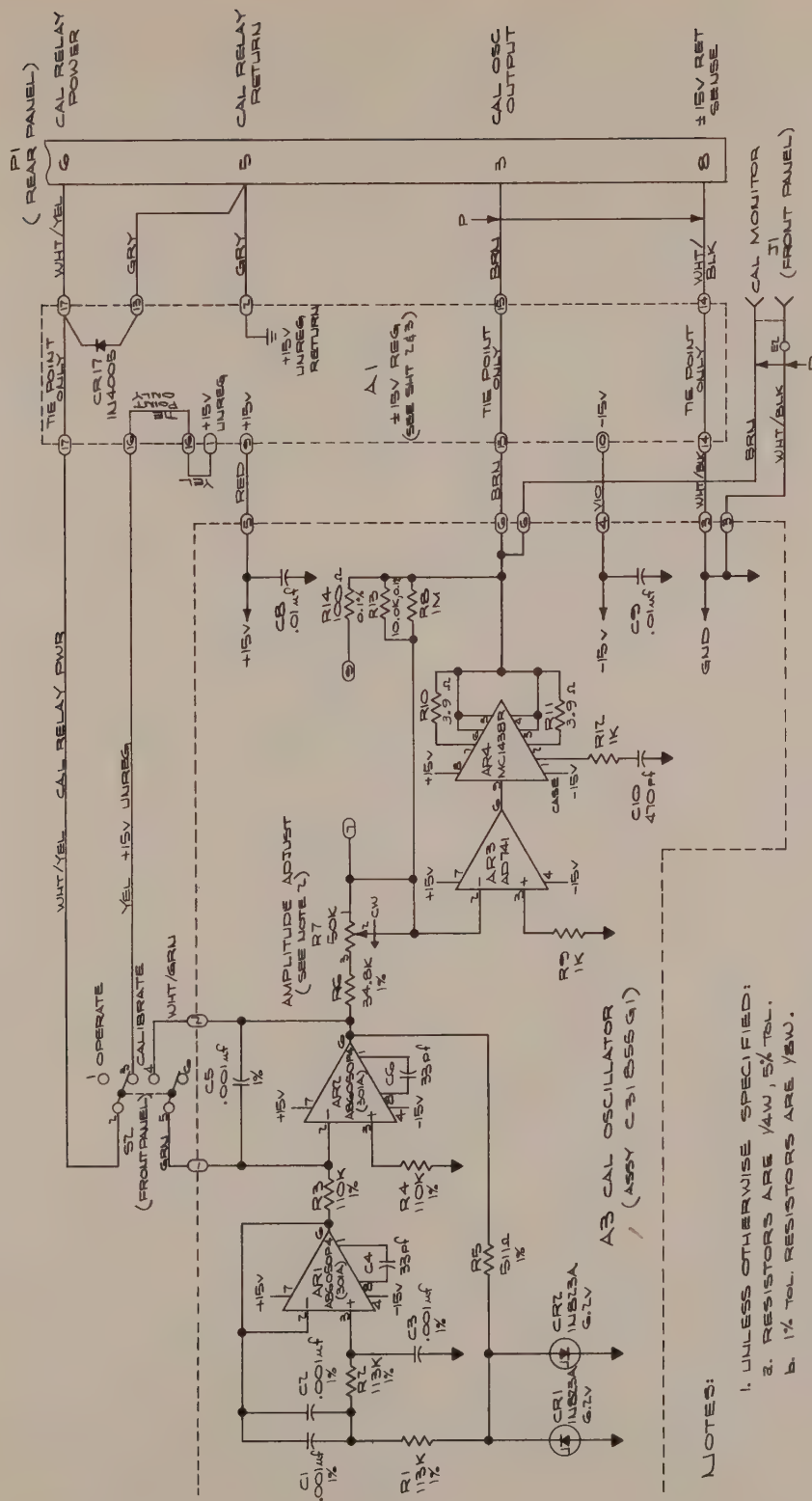
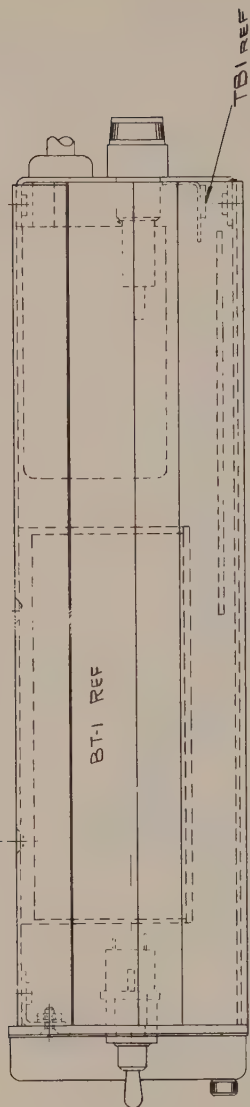
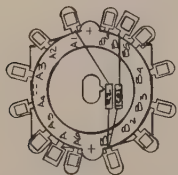


FIGURE 6.21 P13 AND P16 SERIES POWER SUPPLIES – CAL SYSTEM – SCHEMATIC



TBI REF

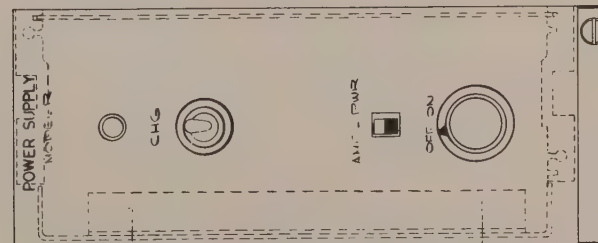
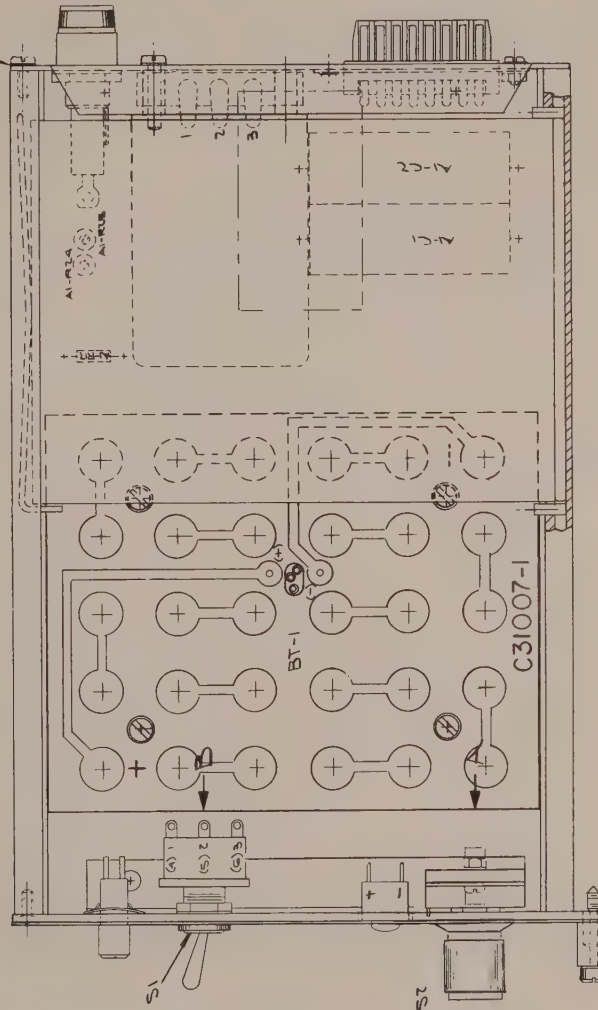
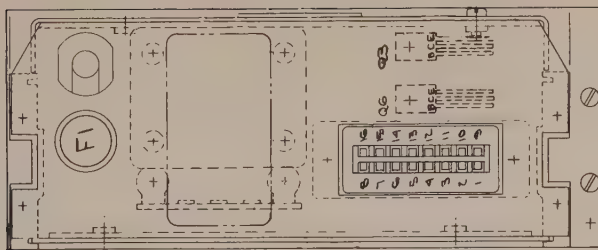




FIGURE 6.24 R POWER SUPPLY – WIRING DIAGRAM

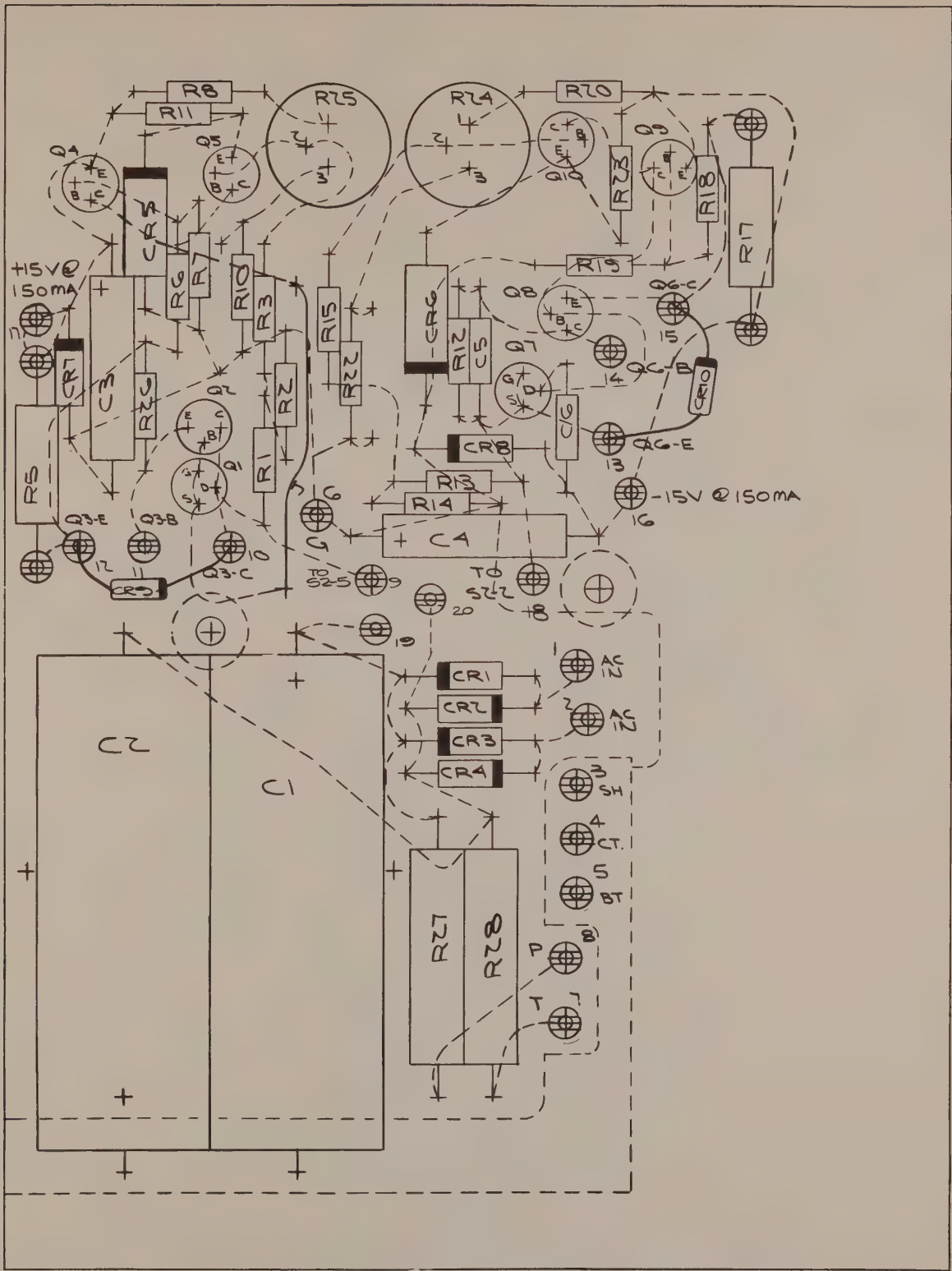


FIGURE 6.25 R POWER SUPPLY - CARD ASSEMBLY

SECTION 7

7.0 REPLACEABLE PARTS

7.1 INTRODUCTION

This section contains information for ordering replaceable parts. Tables list parts in alphabetical order of their reference designation and indicates the description and manufacturer's part number. When applicable, a typical manufacturer is indicated.

7.2 REFERENCE DESIGNATIONS AND ABBREVIATIONS

Table 7.1 is a list of reference designations and abbreviations.

7.3 CODE LIST OF MANUFACTURERS

Table 7.3 is a Code List of Manufacturers. The manufacturer's code is given with each part. If a code number is missing, the part is a standard designation and available from many manufacturers.

REFERENCE DESIGNATIONS

A	assembly subassembly, separable or repairable	H	hardware		plug, electrical (connector, movable portion)
AR	amplifier	HR	heater lamp, infrared	PS	power supply
AT	attenuator pad termination	HS	handset	Q	transistor
B	blower motor synchro	HY	network, hybrid circuit	R	potentiometer resistor
BT	battery	J	connector, receptacle, electrical disconnecting device jack receptacle (connector, stationary portion)	RT	lamp, resistance resistor, current regulating resistor, thermal thermistor
C	capacitor	K	relay	RV	resistor, voltage sensitive varistor, symmetrical
CB	circuit breaker	L	coil (all not classified as transformers) inductor	S	switch thermostat
CP	adapter, connector coupling (aperture, loop or probe) junction (coaxial or waveguide)	M	clock counter, electrical meter oscilloscope oscilloscope recorder, elapsed time register, message strain gage thermometer timer, electric	T	transformer
CR	diode rectifier	MP	frame gyroscope interlock, mechanical mechanical part mounting (not electrical circuit, not a socket) part, miscellaneous mechanical (bearing, coupling, gear, shaft) part, structural reed, vibration tuning fork	TB	strip, terminal terminal board
DS	alarm indicator (excluding meter)	MK	microphone	TC	thermocouple
E	antenna arrester, lightning bimetallic strip cell, aluminum or electrolytic contact core, inductor core, memory core, transformer Hall effect device insulator loop antenna magnet, permanent part, miscellaneous electrical post, binding shield, electrical terminal (individual)	MT	transducer transducer, mode	TP	test point
F	fuse	P	connector, plug, electrical disconnecting device (connector, plug)	U	integrated circuit package
FL	filter			V	cell, light-sensitive, photo- emissive electron tube
G	chopper, electronic generator			W	cable cable assembly (with connectors) wire
				WT	tiepoint, wiring
				X	fuseholder lampholder socket
				Y	crystal unit, piezoelectric

ABBREVIATIONS

A	ampere	GE	germanium	N	nano (10^{-9})	RF	radio frequency
AC	alternating current	GL	glass	N/C	normally closed	RMS	root-means-square
ALUM	aluminum	GND	ground	NE	neon		
AMPL	amplifier			N/O	normally open	S-B	slow-blow
ASSY	assembly	H	henries	NPO	negative positive zero	SCR	screw
		HPF	high-pass filter	NSR	not separately replaceable	SE	selenium
BP	bandpass	HR	hour			SEC	second
		Hz	hertz			SECT	section(s)
CAL	calibration			OSC	oscillator	SEMICON	semiconductor
CAR	carbon	IF	intermediate frequency	OP	operational	SI	silicon
CCW	counterclockwise	INS	insulation(ed)	PC	printed circuit	SIL	silver
CER	ceramic	INT	internal	PF	picofarads 10^{-12} farads	SL	slide
CKT	circuit	K	kilo = 1000	PIV	peak inverse volt voltage	SOL	solid
COMP	composition	LED	light emitting diode	P/P	part of	SPL	special
CRT	cathode-ray tube	LIN	linear taper	PPM	parts per million	TA	tantalum
CW	clockwise	LOG	logarithmic taper	POLY	polystyrene	TGL	toggle
		LPF	low-pass filter	POLYCARB	poly carbonate	TOL	tolerance
				POS	position(s)	TRIM	trimmer
ELECT	electrolytic	M	Millo 10^{-3}	POT	potentiometer		
ENCAP	encapsulated	MEG	meg 10^6	P-P	peak-to-peak	μ	micro 10^{-6}
EXT	external	METFLM	metal film			V	volt
		MFR	manufacturer	RC	resistor capacitor network	VAR	variable
F	farads	MINAT	miniature	RECT	rectifier	VDCW	dc working volts
FET	field effect transistor	MOM	momentary	REF	reference	VCO	voltage controlled oscillator
FREQ	frequency	MTG	mounting			W/	with
FXD	fixed	MYFLM	"mylar" film			W	watts
						WW	wirewound
						W/O	without

TABLE 7.1 LIST OF REFERENCE DESIGNATIONS AND ABBREVIATIONS

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A1	BASIC ASSEMBLY	D41565G1		
	-15/+15V REGULATOR CARD ASM	C31386G1		
	AR1 Op Amp LM301A	A86050P4	31	A86050P4
	AR2 Op Amp LM301A	A86050P4	31	A86050P4
CAPACITORS				
C1	1900 μ f, 50V, Alum Foil	811530018	48	39D198G050JS4
C2	3.3 μ f, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C3	100pf, 500V, Sil Mica	811581008	74	DM15D101J
C4	6.8 μ f, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C5	33 μ f, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C6	100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C7	100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C8	1900 μ f, 50V, Alum Foil	811530018	48	39D198G050JS4
C9	3.3 μ f, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C10	100pf, 500V, Sil Mica	811581008	79	DM15D101J
C11	6.8 μ f, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C12	33 μ f, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C13	100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C14	100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
DIODES				
CR1	RECT	818100007		IN4005
CR2	RECT	818100007		IN4005
CR3	RECT	818100007		IN4005
CR4	RECT	818100007		IN4005
CR5	RECT	818100007		IN4005
CR6	ZENER, 6.2V	818175002		IN823A
CR7	RECT	818100007		IN4005
CR8	RECT	818100007		IN4005
CR9	RECT	818100007		IN4005
CR10	RECT	818100007		IN4005

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A1	-15/+15V REGULATOR CARD ASM (continued)			
	DIODES (continued)			
CR11	RECT	818100007		IN4005
CR12	RECT	818100007		IN4005
CR13	ZENER 6.2V	818175002		IN823A
CR14	RECT	818100007		IN4005
CR15	RECT	818100007		IN4005
CR16	RECT	818100007		IN4005
CR17	RECT	818100007		IN4005
	TRANSISTORS			
Q1	PNP	818203906		2N3906
Q2	NPN	818203904		2N3904
Q3	FET	818204093		2N4093
Q4	NPN	818203904		2N3904
Q5	PNP	818203906		2N3906
Q6	PNP	818205464		2N5464
	RESISTORS			
R1	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R2	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R3	150k, 1/4W, 5%, Fxd Comp	817007154		RC07
R4	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R5	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R6	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R7	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R8	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R9	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R10	2.2k, 1/4W, 5%, Fxd Comp	817117222		RC07
R11	Pot, 1k	817801019	29	66WR1K
R12	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R13	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R14	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R15	150k, 1/4W, 5%, Fxd Comp	817007154		RC07

TABLE 7.2 REPLACEABLE PARTS

MODEL P11 ASSEMBLY D41566 G1 (continued)

REFERENCE DESIGNATION	DESCRIPTION	ITHACO PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A1	-15/+15V Regulator Card Asm (cont) RESISTORS (continued)			
R16	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R17	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R18	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R19	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R20	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R21	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R22	2.2k, 1/4W, 5%, Fxd Comp	817007222		RC07
R23	Pot, 1K	817801019	29	66WR1K
R24	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R25	15k, 1/4W, 5%, Fxd Comp	817007153		RC07
R26	100k, 1/4W, 5%, Fxd Comp	817007104		RC07
F1	Fuse, 1 1/2A Fast Acting	815183013	9	AGC
P1	Connector, 16 Pin	812122003	4	26-4100-16P
Q1	Transistor, Power	818700017		MJE-1092
	RESISTORS			
R1	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-A65
R2	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R3	27k, 1/4W, 5%, Fxd Comp	817007273		RC07
S1-DS1	Switch, Neon-Lighted	815160007	34	616-6-1-A1H
T1	Transformer	B88100P1	31	B88100P1
XA2	Connector, 10 Pin	812127004	94	C-404-010

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A1	BASIC ASSEMBLY	D41565G1		
	-15/+15V REGULATOR CARD ASM	C31386G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
AR2	Op Amp LM301A	A86050P4	31	A86050P4
CAPACITORS				
C1	1900 μ f, 50V, Alum Foil	811530018	48	39D198G050JS4
C2	3.3 μ f, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C3	100pf, 500V, Sil Mica	811581008	74	DM15D101J
C4	6.8 μ f, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C5	33 μ f, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C6	100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C7	100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C8	1900 μ f, 50V, Alum Foil	811530018	48	39D198G050JS4
C9	3.3 μ f, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C10	100pf, 500V, Sil Mica	811581008	79	DM15D101J
C11	6.8 μ f, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C12	33 μ f, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C13	100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C14	100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
DIODES				
CR1	RECT	818100007		IN4005
CR2	RECT	818100007		IN4005
CR3	RECT	818100007		IN4005
CR4	RECT	818100007		IN4005
CR5	RECT	818100007		IN4005
CR6	ZENER, 6.2V	818175002		IN823A
CR7	RECT	818100007		IN4005
CR8	RECT	818100007		IN4005
CR9	RECT	818100007		IN4005
CR10	RECT	818100007		IN4005

TABLE 7.2 REPLACEABLE PARTS

MODEL P12 ASSEMBLY D41566 G2 (continued)

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A1	-15/+15V Regulator Card Asm(cont)			
	DIODES (continued)			
CR11	RECT	818100007		IN4005
CR12	RECT	818100007		IN4005
CR13	ZENER 6.2V	818175002		IN823A
CR14	RECT	818100007		IN4005
CR15	RECT	818100007		IN4005
CR16	RECT	818100007		IN4005
CR17	RECT	818100007		IN4005
	TRANSISTORS			
Q1	PNP	818203906		2N3906
Q2	NPN	818203904		2N3904
Q3	FET	818204093		2N4093
Q4	NPN	818203904		2N3904
Q5	PNP	818203906		2N3906
Q6	PNP	818205464		2N5464
	RESISTORS			
R1	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R2	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R3	150k, 1/4W, 5%, Fxd Comp	817007154		RC07
R4	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R5	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R6	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R7	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R8	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R9	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R10	2.2k, 1/4W, 5%, Fxd Comp	817117222		RC07
R11	Pot, 1k	817801019	29	66WR1K
R12	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R13	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R14	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R15	150k, 1/4W, 5%, Fxd Comp	817007154		RC07

TABLE 7.2 REPLACEABLE PARTS

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A1	-15/+15V Regulator Card Asm (cont)			
	RESISTORS (continued)			
R16	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R17	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R18	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R19	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R20	1.18k, 1/8W, 1%, Metfilm	817211118		RN60D
R21	9.09k, 1/8W, 1%, Metfilm	817211909		RN60D
R22	2.2k, 1/4W, 5%, Fxd Comp	817007222		RC07
R23	Pot, 1k	817801019		66WR1K
R24	6.19k, 1/8W, 1%, Metfilm	817211619		RN60D
R25	15k, 1/4W, 5%, Fxd Comp	817007153		RC07
R26	100k, 1/4W, 5%, Fxd Comp	817007104		RC07
A2	±28V REGULATOR CARD ASSEMBLY	C31387G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
	CAPACITORS			
C1	350μf, 75V, Alum Foil	811530022	48	39D357G075GL4
C3	100pf, 500V, 5%, Sil Mica	811581008	79	DM15D101J
C4	6.8μf, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C5	33μf, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C6	47μf, 35V, 10%, Sol Ta	811501215	48	150D476X9035S2
	DIODES			
CR1	RECT	818100007		IN4005
CR2	RECT	818100007		IN4005
CR3	RECT	818100007		IN4005
CR4	RECT	818100007		IN4005
CR5	RECT	818100007		IN4005
CR6	ZENER SZ6.5V	818150015	46	SZ6.5V
CR7	RECT	818100007		IN4005
CR8	RECT	818100007		IN4005

REFERENCE DESIGNATION	DESCRIPTION	ITHACO PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A2	TRANSISTORS			
Q1	PNP	818204920		2N4920
Q2	PNP	818700020		2N3251A
Q3	PNP	818700020		2N3251A
Q4	NPN	818700006		2N718A
Q5	U1673	A86039P5	31	A86039P5
	RESISTORS			
R1	100 ohm, 1/4W, 5%, Fxd Comp	817007101		RC07
R2	100k, 1/4W, 5%, Fxd Comp	817007104		RC07
R3	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R4	2.7k, 1/4W, 5%, Fxd Comp	817007272		RC07
R5	27k, 1/2W, 5%, Fxd Comp	817020273		RC20
R6	4.7 ohm, 1/2W, 5%, Fxd Comp	817020479		RC20
R9	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R10	5.6k, 1/4W, 5%, Fxd Comp	817007562		RC07
R11	1.96k, 1/8W, 1%, Metflm	817211196		RN60D
R12	22.1k, 1/8W, 1%, Metflm	817212221		RN60D
R13	6.65k, 1/8W, 1%, Metflm	817211665		RN60D
F1	Fuse, 1 1/2A Fast Acting	815183013	9	AGC
P1	Connector, 16 Pin	812122003	4	26-4100-16P
Q1	Transistor, Power	818700017		MJE1092
	RESISTORS			
R1	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R2	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R3	27k, 1/4W, 5%, Fxd Comp	817007273		RC07
S1-DS1	Switch, Neon-Lighted	815160007	34	616-61-1A1H
T1	Transformer	B88100P1	31	B88100P1
XA2	Connector, 10 Pin	812127004	94	C-404-010

MODEL P13 ASSEMBLY D41566 G3

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A1	BASIC ASSEMBLY	D41565G1		
	-15/+15V REGULATOR CARD ASM	C31386G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
AR2	Op Amp LM301A	A86050P4	31	A86050P4
CAPACITORS				
C1	1900 μ f, 50V, Alum Foil	811530018	48	39D198G050JS4
C2	3.3 μ f, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C3	100pf, 500V, Sil Mica	811581008	74	DM15D101J
C4	6.8 μ f, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C5	33 μ f, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C6	100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C7	100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C8	1900 μ f, 50V, Alum Foil	811530018	48	39D198G050JS4
C9	3.3 μ f, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C10	100pf, 500V, Sil Mica	811581008	79	DM15D101J
C11	6.8 μ f, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C12	33 μ f, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C13	100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C14	100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
DIODES				
CR1	RECT	818100007		IN4005
CR2	RECT	818100007		IN4005
CR3	RECT	818100007		IN4005
CR4	RECT	818100007		IN4005
CR5	RECT	818100007		IN4005
CR6	ZENER, 6.2V	818175002		IN823A
CR7	RECT	818100007		IN4005
CR8	RECT	818100007		IN4005
CR9	RECT	818100007		IN4005
CR10	RECT	818100007		IN4005

TABLE 7.2 REPLACEABLE PARTS

MODEL P13 ASSEMBLY D41566G3 (continued)

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A1	-15/+15 Regulator Card Asm (cont)			
	DIODES (continued)			
CR11	RECT	818100007		IN4005
CR12	RECT	818100007		IN4005
CR13	ZENER 6.2V	818175002		IN823A
CR14	RECT	818100007		IN4005
CR15	RECT	818100007		IN4005
CR16	RECT	818100007		IN4005
CR17	RECT	818100007		IN4005
	TRANSISTORS			
Q1	PNP	818203906		2N3906
Q2	NPN	818203904		2N3904
Q3	FET	818204093		2N4093
Q4	NPN	818203904		2N3904
Q5	PNP	818203906		2N3906
Q6	PNP	818205464		2N5464
	RESISTORS			
R1	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R2	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R3	150k, 1/4W, 5%, Fxd Comp	817007154		RC07
R4	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R5	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R6	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R7	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R8	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R9	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R10	2.2k, 1/4W, 5%, Fxd Comp	817117222		RC07
R11	Pot, 1k	817801019	29	66WR1K
R12	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R13	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R14	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R15	150k, 1/4W, 5%, Fxd Comp	817007154		RC07

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A1	-15/+15V Regulator Card Asm (cont)			
	RESISTORS (cont)			
R16	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R17	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R18	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R19	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R20	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R21	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R22	2.2k, 1/4W, 5%, Fxd Comp	817007222		RC07
R23	Pot, 1k	817801019	29	66WR1K
R24	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R25	15k, 1/4W, 5%, Fxd Comp	817117153		RC07
R26	100k, 1/4W, 5%, Fxd Comp	817007104		RC07
A2	±28V REGULATOR CARD ASSEMBLY	C31387G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
	CAPACITORS			
C1	350μf, 75V, Alum Foil	811530022	48	39D357G075GL4
C3	100pf, 500V, 5%, Sil Mica	811581008	79	DM15D101J
C4	6.8μf, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C5	33μf, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C6	47μf, 35V, 10%, Sol Ta	811501215	48	150D476X9035S2
	DIODES			
CR1	RECT	818100007		IN4005
CR2	RECT	818100007		IN4005
CR3	RECT	818100007		IN4005
CR4	RECT	818100007		IN4005
CR5	RECT	818100007		IN4005
CR6	ZENER SZ6.5V	818150015	46	SZ6.5V
CR7	RECT	818100007		IN4005
CR8	RECT	818100007		IN4005

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A2	±28V Regulator Card Asm (cont)			
	TRANSISTORS			
Q1	PNP	818204920		2N4920
Q2	PNP	818700020		2N3251A
Q3	PNP	818700020		2N3251A
Q4	NPN	818700006		2N718A
Q5	U1673	A86039P5	31	A86039P5
	RESISTORS			
R1	100 ohm, 1/4W, 5%, Fxd Comp	817007101		RC07
R2	100k, 1/4W, 5%, Fxd Comp	817007104		RC07
R3	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R4	2.7k, 1/4W, 5%, Fxd Comp	817007272		RC07
R5	27k, 1/2W, 5%, Fxd Comp	817020273		RC20
R6	4.7 ohm, 1/2W, 5%, Fxd Comp	807020479		RC20
R9	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R10	5.6k, 1/4W, 5%, Fxd Comp	817007562		RC07
R11	1.96k, 1/8W, 1%, Metflm	817211196		RN60D
R12	22.1k, 1/8W, 1%, Metflm	817212221		RN60D
R13	6.65k, 1/8W, 1%, Metflm	817211665		RN60D
A3	CAL OSCILLATOR CARD ASSEMBLY	C31855G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
AR2	Op Amp LM301A	A86050P4	31	A86050P4
AR3	Op Amp AD741	816400019	5	AD741
AR4	Op Amp MC1438R	816400014	35	MC1438R
	CAPACITORS			
C1	.001μf, 500V, 1%, Sil Mica	811581049	79	DM15D102F
C2	.001μf, 500V, 1%, Sil Mica	811581049	79	DM15D102F
C3	.001μf, 500V, 1%, Sil Mica	811581049	79	DM15D102F
C4	33pf, 500V, Sil Mica	811581037	79	DM15D330J
C5	.001μf, 500V, 1%, Sil Mica	811581049	79	DM15D102F

MODEL P13 ASSEMBLY D41566G3 (continued)

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A3	CAL OSCILLATOR CARD ASM (cont)			
	CAPACITORS (continued)			
C6	33pf, 500V, Sil Mica	811581037	79	DM15D330J
C8	.01μf, 500V, 20%, Cer	811570019	48	5GAS-S10
C9	.01μf, 500V, 20%, Cer	811570019	48	5GAS-S10
C10	470pf, 500V, Sil Mica	811581014	79	DM15D471J
CR1	IN823A, 6.2V Diode	818175002		IN823A
CR2	IN823A, 6.2V Diode	818175002		IN823A
	RESISTORS			
R1	113k, 1/8W, 1%, Metflm	817213113		RN60D
R2	113k, 1/8W, 1%, Metflm	817213113		RN60D
R3	110k, 1/8W, 1%, Metflm	817213110		RN60D
R4	110k, 1/8W, 1%, Metflm	817213110		RN60D
R5	511 ohm, 1/8W, 1%, Metflm	817210511		RN60D
R6	34.8k, 1/8W, 1%, Metflm	817212348		RN60D
R7	Pot, 50k	817806503	7	3299X-1-503
R8	1M, 1/4W, 5%, Fxd Comp	817007105		RC07
R9	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R10	3.9 ohm, 1/4W, 5%, Fxd Comp	817007399		RC07
R11	3.9 ohm, 1/4W, 5%, Fxd Comp	807007399		RC07
R12	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R13	10.0k, 1/8W, 0.1%, Metflm	817261048	42	PME55
R14	100 ohm, 1/8W, 0.1%, Metflm	817261032	42	PME55
S1	Switch, Rotary 3P 3 pos N-S	A88390P1	31	A88390P1
S2	Switch, Toggle DPDT	815111007	14	7201
F1	Fuse, 1 1/2A, Fast Acting	816183013	9	AGC
J1	Connector, BNC	812130110	19	30355-1
P1	Connector, 16 Pin	812122003	4	26-4100-16P
Q1	Transistor, Power	818700017		MJE1092

MODEL P13 ASSEMBLY D41566G3 (continued)

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
R1	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R2	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R3	27k, 1/4W, 5%, Fxd Comp	817007273		RC07
S1-DS1	Switch, Neon-Lighted	815160007	34	616-6-1-A1H
T1	Transformer	B88100P1	31	B88100P1
XA2	Connector, 10 Pin	812127004	94	C-404-010

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A1	BASIC ASSEMBLY	D41565G1		
	-15/+15V REGULATOR CARD ASM	C31386G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
AR2	Op Amp LM301A	A86050P4	31	A86050P4
CAPACITORS				
C1	1900 μ f, 50V, Alum Foil	811530018	48	39D198G050JS4
C2	3.3 μ f, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C3	100pf, 500V, Sil Mica	811581008	74	DM15D101J
C4	6.8 μ f, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C5	33 μ f, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C6	100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C7	100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C8	1900 μ f, 50V, Alum Foil	811530018	48	39D198G050JS4
C9	3.3 μ f, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C10	100pf, 500V, Sil Mica	811581008	79	DM15D101J
C11	6.8 μ f, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C12	33 μ f, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C13	100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C14	100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
DIODES				
CR1	RECT	818100007		IN4005
CR2	RECT	818100007		IN4005
CR3	RECT	818100007		IN4005
CR4	RECT	818100007		IN4005
CR5	RECT	818100007		IN4005
CR6	ZENER, 6.2V	818175002		IN823A
CR7	RECT	818100007		IN4005
CR8	RECT	818100007		IN4005
CR9	RECT	818100007		IN4005
CR10	RECT	818100007		IN4005

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A1	-15/+15V Regulator Card Asm (cont)			
	DIODES (continued)			
CR11	RECT	818100007		IN4005
CR12	RECT	818100007		IN4005
CR13	ZENER 6.2V	818175002		IN823A
CR14	RECT	818100007		IN4005
CR15	RECT	818100007		IN4005
CR16	RECT	818100007		IN4005
CR17	RECT	818100007		IN4005
	TRANSISTORS			
Q1	PNP	818203906		2N2906
Q2	NPN	818203904		2N3904
Q3	FET	818204093		2N4093
Q4	NPN	818203904		2N3904
Q5	PNP	818203906		2N3906
Q6	PNP	818205464		2N5464
	RESISTORS			
R1	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R2	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R3	150k, 1/4W, 5%, Fxd Comp	817007154		RC07
R4	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R5	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R6	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R7	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R8	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R9	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R10	2.2k, 1/4W, 5%, Fxd Comp	817117222		RC07
R11	Pot, 1k	817801019	29	66WR1K
R12	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R13	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R14	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R15	150k, 1/4W, 5%, Fxd Comp	817007154		RC07

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A1	-15/+15V Regulator Card Asm(cont)			
	RESISTORS (cont)			
R16	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R17	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R18	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R19	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R20	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R21	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R22	2.2k, 1/4W, 5%, Fxd Comp	817007222		RC07
R23	Pot, 1k	817801019	29	66WR1K
R24	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R25	15k, 1/4W, 5%, Fxd Comp	817007104		RC07
R26	100k, 1/4W, 5%, Fxd Comp	817007104		RC07
A2	-55V REGULATOR CARD ASSEMBLY	C31388G1		
ARI	Op Amp LM301A	A86050P4	31	A86050P4
	CAPACITORS			
C1	350μf, 75V, Alum Foil	811530022	48	39D357G075GL4
C2	350μf, 75V, Alum Foil	811530022	48	39D357G075GL4
C3	100pf, 500V, 5%, Sil Mica	811581008	79	DM15D101J
C4	22μf, 100V, 20%, Sol Ta	811500006	48	109D226X1000F2
C5	22μf, 100V, 20%, Sol Ta	811500006	48	109D226X1000F2
C6	3.3μf, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
	DIODES			
CR1	RECT	818100007		IN4005
CR2	RECT	818100007		IN4005
CR3	RECT	818100007		IN4005
CR4	SI	818100003		IN4148
CR5	RECT	818100007		IN4005
CR6	RECT	818100007		IN4005
CR7	RECT	818100007		IN4005
CR8	RECT	818100007		IN4005

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A2	-55V REGULATOR CARD ASM (cont)	C31388G1		
	TRANSISTORS			
Q1	NPN	818700019		MPSU03
Q2	PNP	818205401		2N5401
Q3	PNP	818203906		2N3906
Q4	NPN	818203904		2N3904
	RESISTORS			
R1	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R2	3.9k, 1/2W, 5%, Fxd Comp	817020392		RC20
R3	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R4	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R5	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R6	56k, 1/4W, 5%, Fxd Comp	817007563		RC07
R7	2.7k, 1/4W, 5%, Fxd Comp	817007272		RC07
R8	9.1 ohm, 1/4W, 5%, Fxd Comp	817007919		RC07
R9	10.0k, 1/8W, 1%, Metflm	817212100		RN60D
R10	15k, 1/4W, 5%, Fxd Comp	817007153		RC07
R11	56.2k, 1/8W, 1%, Metflm	817212562		RN60D
R12	10.0k, 1/8W, 1%, Metflm	817212100		RN60D
R13	5.11k, 1/8W, 1%, Metflm	817211511		RN60D
F1	Fuse, 1 1/2A Fast Acting	815183013	9	AGC
P1	Connector, 16 Pin	812122003	4	26-4100-16P
Q1	Transistor, Power	818600017		MJE1092
	RESISTORS			
R1	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R2	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R3	27k, 1/4W, 5%, Fxd Comp	817007273		RC07
S1-DS1	Switch, Neon Lighted	815160007	34	616-6-1-A1H
T1	Transformer	B88100P1	31	B88100P1
XA2	Connector, 10 Pin	812127004	94	C-404-010

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A1	BASIC ASSEMBLY	D41565G1		
	-15/+15V REGULATOR CARD ASM	C31386G1		
	AR1 Op Amp LM301A	A86050P4	31	A86050P4
	AR2 Op Amp LM301A	A86050P4	31	A86050P4
	CAPACITORS			
	C1 1900 μ f, 50V, Alum Foil	811530018	48	39D198G050JS4
	C2 3.3 μ f, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
	C3 100pf, 500V, Sil Mica	811581008	74	DM15D101J
	C4 6.8 μ f, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
	C5 33 μ f, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
	C6 100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
	C7 100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
	C8 1900 μ f, 50V, Alum Foil	811530018	48	39D198G050JS4
	C9 3.3 μ f, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
	C10 100pf, 500V, Sil Mica	811581008	79	DM15D101J
	C11 6.8 μ f, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
	C12 33 μ f, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
	C13 100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
	C14 100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
	DIODES			
	CR1 RECT	818100007		IN4005
	CR2 RECT	818100007		IN4005
	CR3 RECT	818100007		IN4005
	CR4 RECT	818100007		IN4005
	CR5 RECT	818100007		IN4005
	CR6 ZENER, 6.2V	818175002		IN823A
	CR7 RECT	818100007		IN4005
	CR8 RECT	818100007		IN4005
	CR9 RECT	818100007		IN4005
	CR10 RECT	818100007		IN4005

TABLE 7.2 REPLACEABLE PARTS

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A1	-15/+15V REGULATOR CARD (cont)			
	DIODES (continued)			
CR11	RECT	818100007		IN4005
CR12	RECT	818100007		IN4005
CR13	ZENER 6.2V	818175002		IN823A
CR14	RECT	818100007		IN4005
CR15	RECT	818100007		IN4005
CR16	RECT	818100007		IN4005
CR17	RECT	818100007		IN4005
	TRANSISTORS			
Q1	PNP	818203906		2N3906
Q2	NPN	818203904		2N3904
Q3	FET	818204093		2N4093
Q4	NPN	818203904		2N3904
Q5	PNP	818203906		2N3906
Q6	PNP	818205464		2N5464
	RESISTORS			
R1	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R2	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R3	150k, 1/4W, 5%, Fxd Comp	817007154		RC07
R4	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R5	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R6	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R7	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R8	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R9	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R10	2.2k, 1/4W, 5%, Fxd Comp	817117222		RC07
R11	Pot, 1k	817801019	29	66WR1K
R12	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R13	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R14	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R15	150k, 1/4W, 5%, Fxd Comp	817007154		RC07

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A1	-15/+15V REGULATOR CARD (cont)			
	RESISTORS (continued)			
R16	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R17	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R18	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R19	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R20	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R21	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R22	2.2k, 1/4W, 5%, Fxd Comp	817007222		RC07
R23	Pot, 1k	817801019	29	66WR1K
R24	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R25	15k, 1/4W, 5%, Fxd Comp	817007153		RC07
R26	100k, 1/4W, 5%, Fxd Comp	817007104		RC07
A2	±28V REGULATOR CARD ASSEMBLY	C31387G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
	CAPACITORS			
C1	350μf, 75V, Alum Foil	811530022	48	39D357G075GL4
C3	100pf, 500V, 5%, Sil Mica	811581008	79	DM15D101J
C4	6.8μf, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C5	33μf, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C6	47μf, 35V, 10%, Sol Ta	811501215	48	150D476X9035S2
	DIODES			
CR1	RECT	818100007		IN4005
CR2	RECT	818100007		IN4005
CR3	RECT	818100007		IN4005
CR4	RECT	818100007		IN4005
CR5	RECT	818100007		IN4005
CR6	ZENER SZ6.5V	818100015	46	SZ6.5V
CR7	RECT	818100007		IN4005
CR8	RECT	818100007		IN4005

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A2	±28V REGULATOR CARD ASM (cont)			
	TRANSISTORS			
Q1	PNP	818204920		2N4920
Q2	PNP	818700020		2N3251A
Q3	PNP	818700020		2N3251A
Q4	NPN	818700006		2N718A
Q5	U1673	A86039P5	31	A86039P5
	RESISTORS			
R1	100 ohm, 1/4W, 5%, Fxd Comp	817007101		RC07
R2	100k, 1/4W, 5%, Fxd Comp	817007104		RC07
R3	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R4	2.7k, 1/4W, 5%, Fxd Comp	817007272		RC07
R5	27k, 1/2W, 5%, Fxd Comp	817020273		RC20
R6	4.7 ohm, 1/2W, 5%, Fxd Comp	817020479		RC20
R9	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R10	5.6k, 1/4W, 5%, Fxd Comp	817007562		RC07
R11	1.96k, 1/8W, 1%, Metflm	817211196		RN60D
R12	22.1k, 1/8W, 1%, Metflm	817212221		RN60D
R13	6.65k, 1/8W, 1%, Metflm	817211665		RN60D
A3	CAL OSCILLATOR CARD ASSEMBLY	C31855G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
AR2	Op Amp LM301A	A86050P4	31	A86050P4
AR3	Op Amp AD741	816400019	5	AD741
AR4	Op Amp MC1438R	816400014	35	MC1438R
	CAPACITORS			
C1	.001μf, 500V, 1%, Sil Mica	811581049	79	DM15D102F
C2	.001μf, 500V, 1%, Sil Mica	811581049	79	DM15D102F
C3	.001μf, 500V, 1%, Sil Mica	811581049	79	DM15D102F
C4	33pf, 500V, Sil Mica	811581037	79	DM15D330J
C5	.001μf, 500V, 1%, Sil Mica	811581049	79	DM15D102F

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A3	CAL OSCILLATOR CARD ASM (cont)			
	CAPACITORS (continued)			
C6	33pf, 500V, Sil Mica	811581037	79	DM15D330J
C8	.01μf, 500V, 20%, Cer	811570019	48	5GAS-S10
C9	.01μf, 500V, 20%, Cer	811570019	48	5GAS-S10
C10	470pf, 500V, Sil Mica	811581014	79	DM15D471J
CR1	IN823A, 6.2V Diode	818175002		IN823A
CR2	IN823A, 6.2V Diode	818175002		IN823A
	RESISTORS			
R1	113k, 1/8W, 1%, Metflm	817213113		RN60D
R2	113k, 1/8W, 1%, Metflm	817213113		RN60D
R3	110k, 1/8W, 1%, Metflm	817213110		RN60D
R4	110k, 1/8W, 1%, Metflm	817213110		RN60D
R5	511 ohm, 1/8W, 1%, Metflm	817210511		RN60D
R6	34.8k, 1/8W, 1%, Metflm	817212348		RN60D
R7	Pot, 50k	817806503	7	3299X-1-503
R8	1M, 1/4W, 5%, Fxd Comp	817007105		RC07
R9	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R10	3.9 ohm, 1/4W, 5%, Fxd Comp	817007399		RC07
R11	3.9 ohm, 1/4W, 5%, Fxd Comp	817007399		RC07
R12	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R13	10.0k, 1/8W, 0.1%, Metflm	817261048	42	PME55
R14	100 ohm, 1/8W, 0.1%, Metflm	817261032	42	PME55
S1	Switch, Rotary 3P 3 pos N-S	A88390P1	31	A88390P1
S2	Switch, Toggle DPDT	815111007	14	7201
F1	Fuse, 1 1/3A, Fast Acting	815183013	9	AGC
J1	Connector, BNC	812130110	19	30355-1
P1	Connector, 16 Pin	812122003	4	26-4100-16P
Q1	Transistor, Power	818700017		MJE1092

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
	RESISTORS			
R1	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R2	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R3	27k, 1/4W, 5%, Fxd Comp	817007273		RC07
S1-DS1	Switch, Neon-Lighted	815160007	34	616-6-1-A1H
T1	Transformer	B88100P1	31	B88100P1
XA2	Connector, 10 Pin	812127004	94	C-404-010

TABLE 7.2 REPLACEABLE PARTS

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A1	BASIC ASSEMBLY	D41565G1		
	-15/+15V REGULATOR CARD ASM	C31386G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
AR2	Op Amp LM301A	A86050P4	31	A86050P4
CAPACITORS				
C1	1900 μ f, 50V, Alum Foil	811530018	48	39D198G050JS4
C2	3.3 μ f, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C3	100pf, 500V, Sil Mica	811581008	74	DM15D101J
C4	6.8 μ f, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C5	33 μ f, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C6	100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C7	100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C8	1900 μ f, 50V, Alum Foil	811530018	48	39D198G050JS4
C9	3.3 μ f, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C10	100pf, 500V, Sil Mica	811581008	79	DM15D101J
C11	6.8 μ f, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C12	33 μ f, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C13	100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C14	100 μ f, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
DIODES				
CR1	RECT	818100007		IN4005
CR2	RECT	818100007		IN4005
CR3	RECT	818100007		IN4005
CR4	RECT	818100007		IN4005
CR5	RECT	818100007		IN4005
CR6	ZENER, 6.2V	818175002		IN823A
CR7	RECT	818100007		IN4005
CR8	RECT	818100007		IN4005
CR9	RECT	818100007		IN4005
CR10	RECT	818100007		IN4005

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A1	-15/+15V Regulator Card Asm(cont)			
	DIODES (continued)			
CR11	RECT	818100007		IN4005
CR12	RECT	818100007		IN4005
CR13	ZENER 6.2V	818175002		IN823A
CR14	RECT	818100007		IN4005
CR15	RECT	818100007		IN4005
CR16	RECT	818100007		IN4005
CR17	RECT	818100007		IN4005
	TRANSISTORS			
Q1	PNP	818203906		2N3906
Q2	NPN	818203904		2N3904
Q3	FET	818204093		2N4093
Q4	NPN	818203904		2N3904
Q5	PNP	818203906		2N3906
Q6	PNP	818205464		2N5464
	RESISTORS			
R1	1.5k, 1/4W, 5%, Fxd Comp	817008152		RC07
R2	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R3	150k, 1/4W, 5%, Fxd Comp	817007154		RC07
R4	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R5	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R6	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R7	910 Ohm, 1/4W, 5%, Fxd Comp	817117911		RC07
R8	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R9	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R10	2.2k, 1/4W, 5%, Fxd Comp	817117222		RC07
R11	Pot, 1k	817801019	29	66WR1K
R12	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R13	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R14	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R15	150k, 1/4W, 5%, Fxd Comp	817007154		RC07

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A1	-15/+15V Regulator Card Asm (cont)			
	RESISTORS (continued)			
R16	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R17	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R18	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R19	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R20	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R21	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R22	2.2k, 1/4W, 5%, Fxd Comp	817007222		RC07
R23	Pot, 1k	817801019	29	66WR1K
R24	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R25	15k, 1/4W, 5%, Fxd Comp	817007153		RC07
R26	100k, 1/4W, 5%, Fxd Comp	817007104		RC07
A3	CAL OSCILLATOR CARD ASSEMBLY	C31855G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
AR2	Op Amp LM301A	A86050P4	31	A86050P4
AR3	Op Amp AD741	816400019	5	AD741
AR4	Op Amp MC1438R	816400014	35	MC1438R
	CAPACITORS			
C1	.001μf, 500V, 1%, Sil Mica	811581049	79	DM15D102F
C2	.001μf, 500V, 1%, Sil Mica	811581049	79	DM15D102F
C3	.001μf, 500V, 1%, Sil Mica	811581049	79	DM15D102F
C4	33pf, 500V, Sil Mica	811581037	79	DM15D330J
C5	.001μf, 500V, 1%, Sil Mica	811581049	79	DM15D102F
C6	33pf, 500V, Sil Mica	811581037	79	DM15D330J
C8	.01μf, 500V, 20%, Cer	811570019	48	5GAS-S10
C9	.01μf, 500V, 20%, Cer	811581019	48	5GAS-S10
C10	470pf, 500V, Sil Mica	811581014	79	DM15D471J
	DIODES			
CR1	IN823A, 6.2V	818175002		IN823A
CR2	IN823A, 6.2V	818175002		IN823A

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER	
			CODE	PART NUMBER
A3	CAL OSCILLATOR CARD ASM (cont)	C31855G1		
	RESISTORS			
R1	113k, 1/8W, 1%, Metflm	817213113		RN60D
R2	113k, 1/8W, 1%, Metflm	817213113		RN60D
R3	110k, 1/8W, 1%, Metflm	817213110		RN60D
R4	110k, 1/8W, 1%, Metflm	817213110		RN60D
R5	511 ohm, 1/8W, 1%, Metflm	817210511		RN60D
R6	34.8k, 1/8W, 1%, Metflm	817212348		RN60D
R7	Pot, 50k	817806503	7	3299X-1-503
R8	1M, 1/4W, 5%, Fxd Comp	817007105		RC07
R9	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R10	3.9 ohm, 1/4W, 5%, Fxd Comp	817007399		RC07
R11	3.9 ohm, 1/4W, 5%, Fxd Comp	817007399		RC07
R12	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R13	10.0k, 1/8W, 0.1%, Metflm	817261048	42	PME55
R14	100 ohm, 1/8W, 0.1%, Metflm	817261032	42	PME55
S1	Switch, Rotary 3P 3 Pos, N-S	A88390P1	31	A88390P1
S2	Switch, Toggle, 3P3T	815128002	43	RCL-13-RCB-3
F1	Fuse, 1 1/2A Fast Acting	815183013	9	AGC
J1	Connector, BNC	812130110	19	30355-1
P1	Connector, 16 Pin	812122003	4	26-4100-16P
Q1	Transistor, Power	818700017		MJE1092
	RESISTORS			
R1	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R2	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R3	27k, 1/4W, 5%, Fxd Comp	817007273		RC07
S1-DS1	Switch, Neon-Lighted	815160007	34	616-6-1-A1H
T1	Transformer	B88100P1	31	B88100P1
XA2	Connector, 10 Pin	812127004	94	C-404-010

CODE LIST OF MANUFACTURERS

1	Aerovox	51	D M Steward Mfg
2	Alco Electronic Prod	52	Switchcraft
3	Allen Bradley		
4	Amphenol Connector	53	Teledyne Semiconductor
5	Analog Devices	54	Teledyne Western Wire and Cable
		55	Texas Instruments
6	Belden	56	Thermalloy
7	Bourns	57	TRW
8	Buckeye Stamping		
9	Bussman Mfg	58	United Transformer
		59	Useco
10	Cambion		
11	Cannon, ITT	60	Vactec
12	Centralab		
13	Cinch Mfg	61	Winchester Electronic
14	C & K Components		
15	Continental—Wirt Elec	62	Vishay
16	Corcom	63	ACI
17	Cornell Dubilier Elec	64	IRC
18	CTS	65	EAL
		66	AMP
19	Dage Electric	67	Clarostat Mfg
20	Delevan Electronics	68	Gould Inc
21	Dresser Systems	69	Littlefuse Inc
22	Electrocube	70	General Illumination
23	Electro Motive Mfg		
24	Electronics Applications	71	Signetrics
25	Erie Technological Products	72	Semiconductor Cir
		73	Statek
26	Fairchild Semiconductor	74	Bendix
27	Federal Screw Prod	75	Burndy
		76	American Handle Sales
28	General Electric	77	Varo Semiconductor
		78	Dialco
29	Helipot	79	Elmenco
30	Heyman Mfg	80	Amp Incorporated
31	ITHACO	81	Berg
		82	Comp Corp
32	E F Johnson	83	Hewlett—Packard
		84	Beckman Helipot
33	Litronix	85	Raytheon
		86	Intersil
34	Marco—Oak Industries	87	A H & H
35	Motorola Semiconductor Prod	88	ADC Products
		89	Scanbe
36	National Semiconductor	90	Drake
		91	Victoreen
37	Ohmite Mfg	92	Frost
		93	Sigma
38	Paktron	94	Becon
39	Panduit	95	Microswitch
40	Pomona Electronics		
41	Product Components		
42	Pyrofilm		
43	RCL Electronics		
44	Rembrandt		
45	Rogan		
46	Schauer Mfg		
47	H H Smith		
48	Sprague Electric		
49	Spectrol Electronics		
50	Stancor		

TABLE 7.3 CODE LIST OF MANUFACTURERS

WARRANTY

ITHACO Inc. warrants each instrument to be free of defects in material and workmanship for a period of one year after shipment to the original purchaser; batteries are specifically excluded. Liability under this warranty is limited to repairing or adjusting any instrument returned to the factory for that purpose. The warranty of this instrument is void if the instrument has been modified other than in accordance with written instructions from ITHACO, or if defect or failure is judged by ITHACO to be caused by abnormal conditions of operation, storage or transportation.

This warranty is subject to verification by ITHACO, that a defect or failure exists, and to compliance by the original purchaser with the following instructions:

1. Before returning the instrument, notify ITHACO with full details of the problem; include model number and serial number of the instrument involved.
2. After receiving the above information, ITHACO will give you shipping instructions or service instructions. After receipt of shipping instructions, ship the instrument to ITHACO. Full liability for damage during shipment is borne by the purchaser. It is recommended that instruments shipped to us be fully insured and packed surrounded by at least 2 inches of shock-absorbing material.

ITHACO reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This warranty is expressly in lieu of all other obligations or liabilities on the part of ITHACO, and ITHACO neither assumes, nor authorizes any other person to assume for it, any liability in connection with the sales of ITHACO instruments.

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